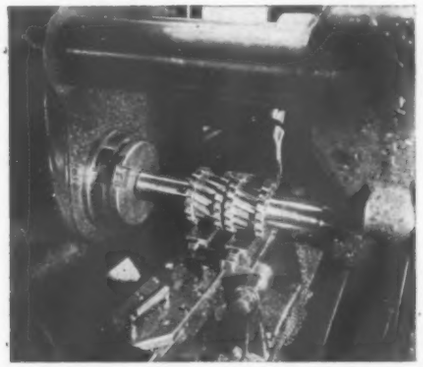
TECHNOLOGY DEPT.

AMERICAN MACHINIST

March 19, 1941



Cutting Corners—*When chips fly on an armament job, a great deal more than efficient cutting performance is at stake*

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VOLUME 85 NUMBER 6

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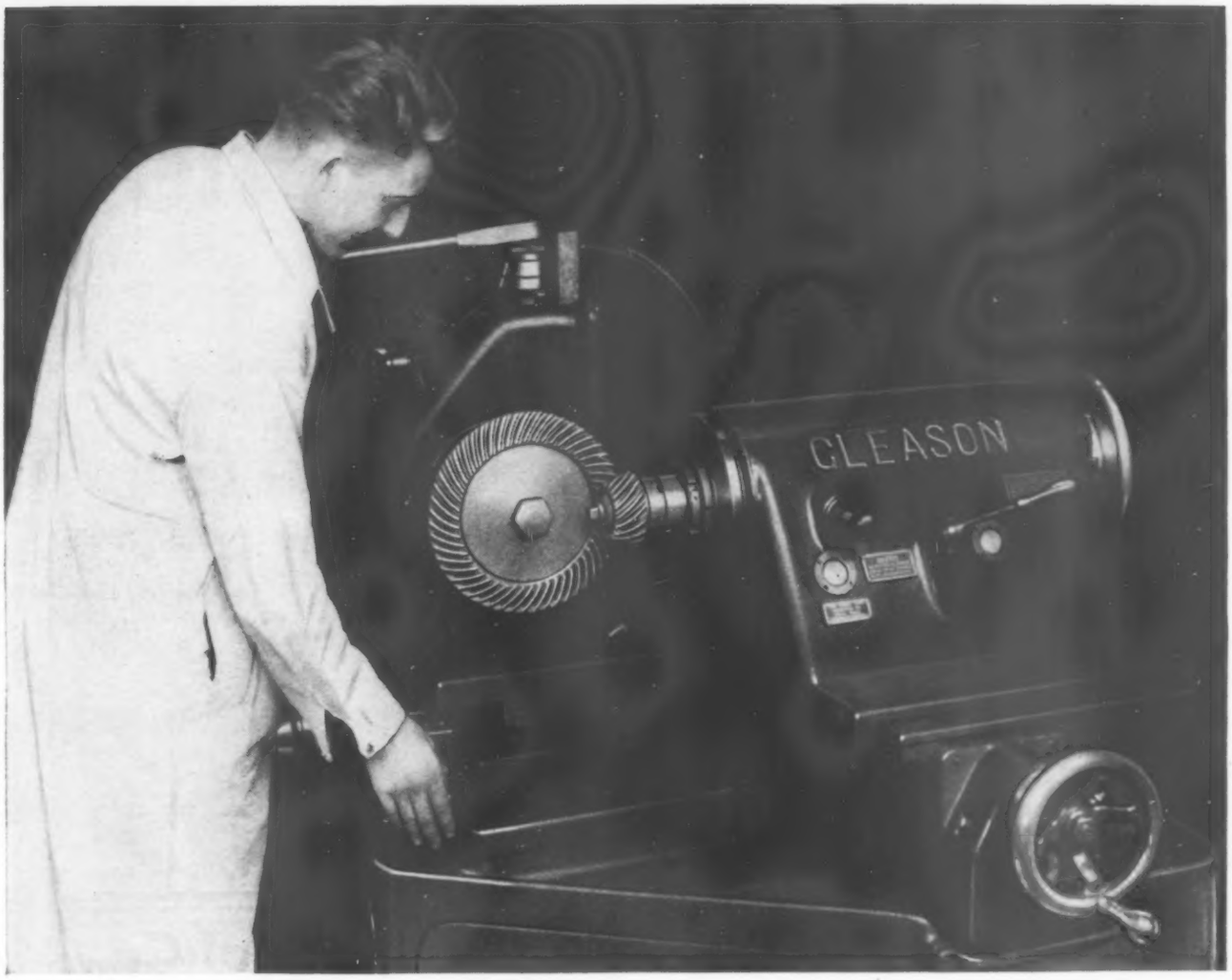
HOW TO USE THIS ISSUE

IF YOU'RE GOING TO THE SHOW . . .

You'll want to check over the Show-In-Print Section, pages 195-208, where you will find descriptions of new equipment to be shown in Detroit next week. You will find a complete list of exhibitors on pages 209-210, designed to help you plan your visit *now,* before you leave. This issue will also serve as a guide at the show, and held for future reference, a permanent record for continuing use. Advertising pages will give you additional information about the products of individual companies.

IF YOU CAN'T MAKE IT THIS YEAR . . .

You'll find this issue more valuable than ever. The Show-In-Print Section, pages 195-208, will introduce new equipment and tell you about the possibilities of this equipment for your plant. Other editorial pages will help you according to your individual needs and interests. And advertising pages will bring the "Show-In-Print" of each advertiser right to your desk. Held for reference, this issue will serve as your record of tool engineering progress for 1941.



THIS TEST CUTS COST AND INSURES SMOOTH, QUIET-RUNNING BEVEL GEARS

THE operator is running these bevel gears in correct position and under load in a Gleason testing machine.

This test not only provides precise control in the manufacture of bevel gears, but it is the one positive way to eliminate the costly mistake of assembling noisy gears.

Such a test checks *all* the conditions required for smooth, quiet-running bevel gears —uniform tooth spacing, teeth concentric with the bore or shank, correct tooth shapes, and exact mounting distances.

Seven sizes of Gleason testing machines cover a range of right-angle and angular bevel gears from 3/16 to 120 inches diameter. Each of these machines has a capacity extending over a wide range of both gear size and ratio. There's a Gleason testing machine to solve your bevel gear problem.

SEND THIS COUPON

GLEASON WORKS, 1B
Rochester, N. Y.

Please send me your new booklet, ***Bevel Gear Testing and Inspection.***

Name _____

Company _____

Address _____

GLEASON WORKS

Builders of Bevel Gear Machinery for Over Seventy-five Years

1000 UNIVERSITY AVENUE, ROCHESTER, N. Y., U. S. A.

DUAL PURPOSE LATHE INCREASES PRODUCTION

How to obtain increased production without increasing floor area, and the number of machines employed in the manufacturing process of the business is one of today's most perplexing problems. If you are confronted with such a situation and the problem has to do with lathe turning, we believe we have a solution. It's the Lodge & Shipley Manufacturing Lathe, a lathe with the adaptability of an engine lathe and the speed and semi-automatic features of an automatic lathe.

Multiple Length Stops provide automatic disengaging of the longitudinal feed at any of five desired positions; Multiple Diameter Stops enable the operator to quickly duplicate diameters, while the Four-way Tool Block with the Connected Rear Rest and additional Rear Tool Block offers innumerable tooling possibilities.

All of the manufacturing lathe attachments can be instantly disengaged and the lathe operated as a standard engine lathe.

Investigate the possibilities of this dual purpose lathe today by sending for your copy of "Examples of Turning".

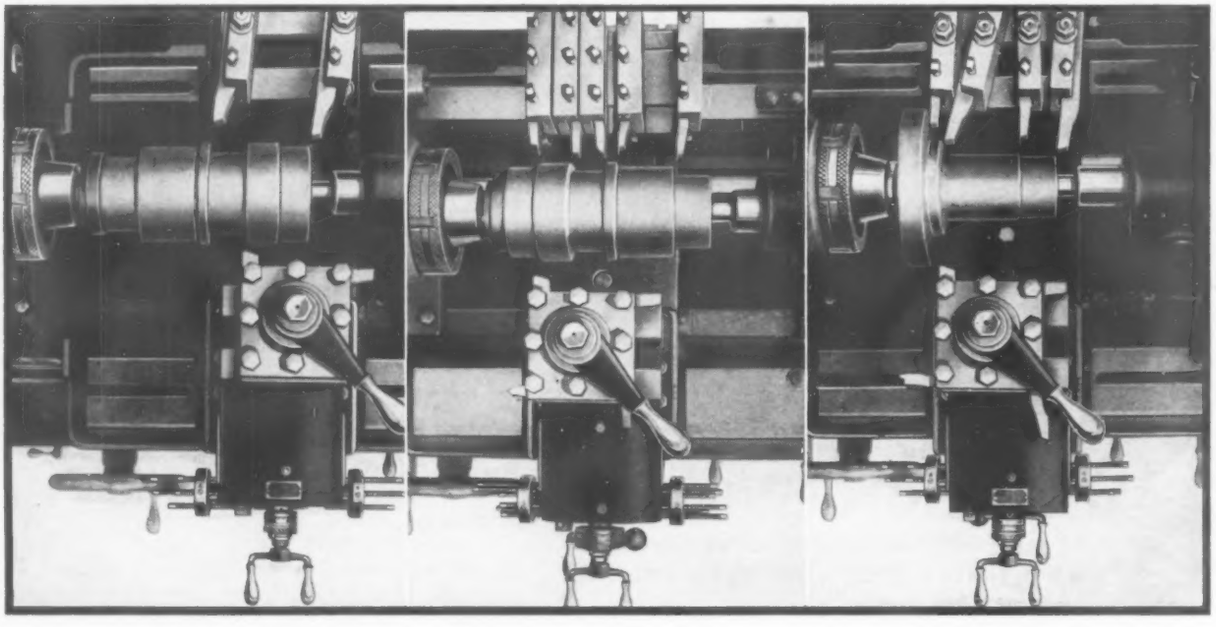
The Lodge & Shipley Machine Tool Co.

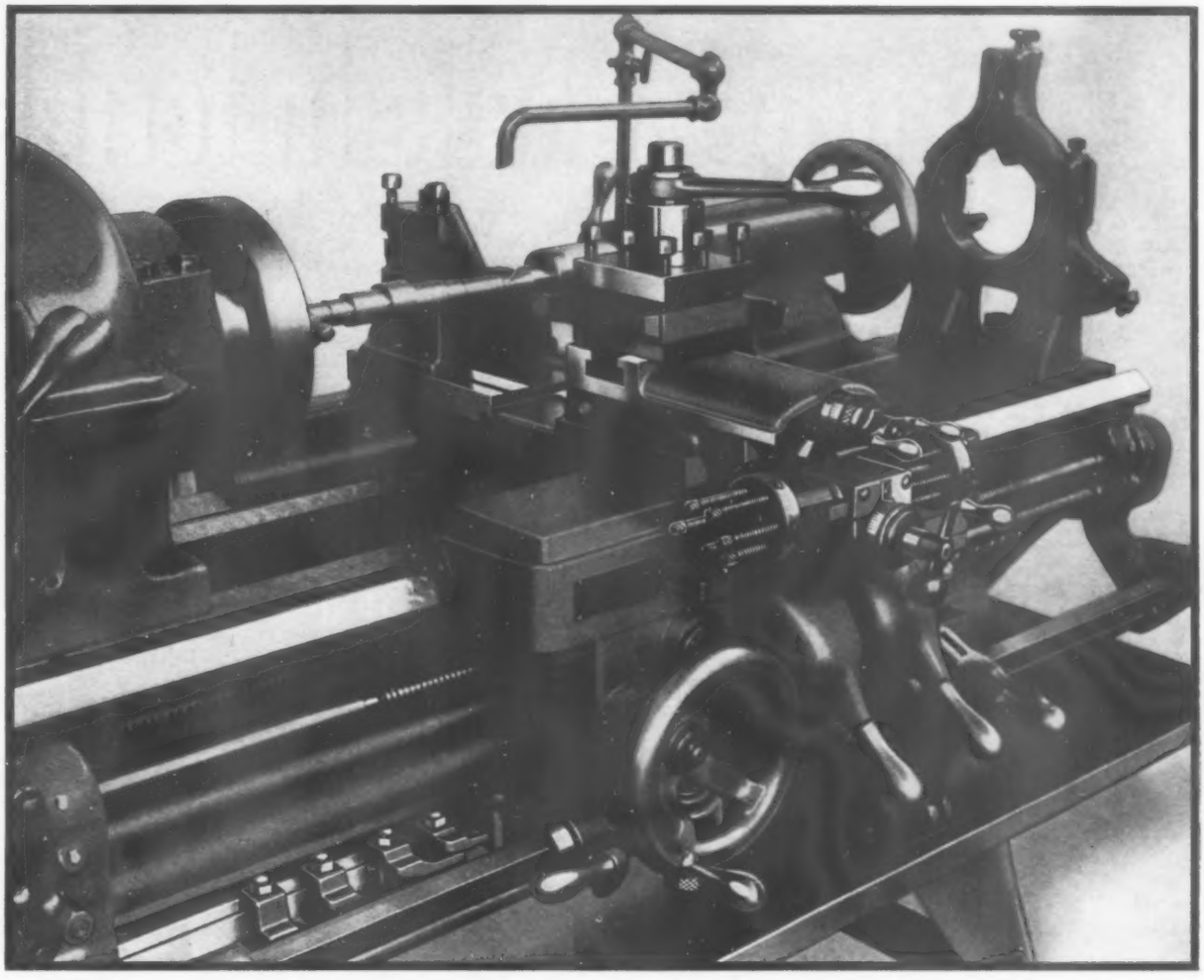
CINCINNATI, OHIO, U. S. A.

One end of sleeve is machined in the first operation using a combination of Swivel Tool Holders and Four-way Tool Block.

In the second operation, sleeve is turned end for end and the remaining operations performed using a Gang and Four-way Tool Block.

Facing and nicking operations on gear blank using four Swivel Tool Holders in the rear and a Four-way in the front.



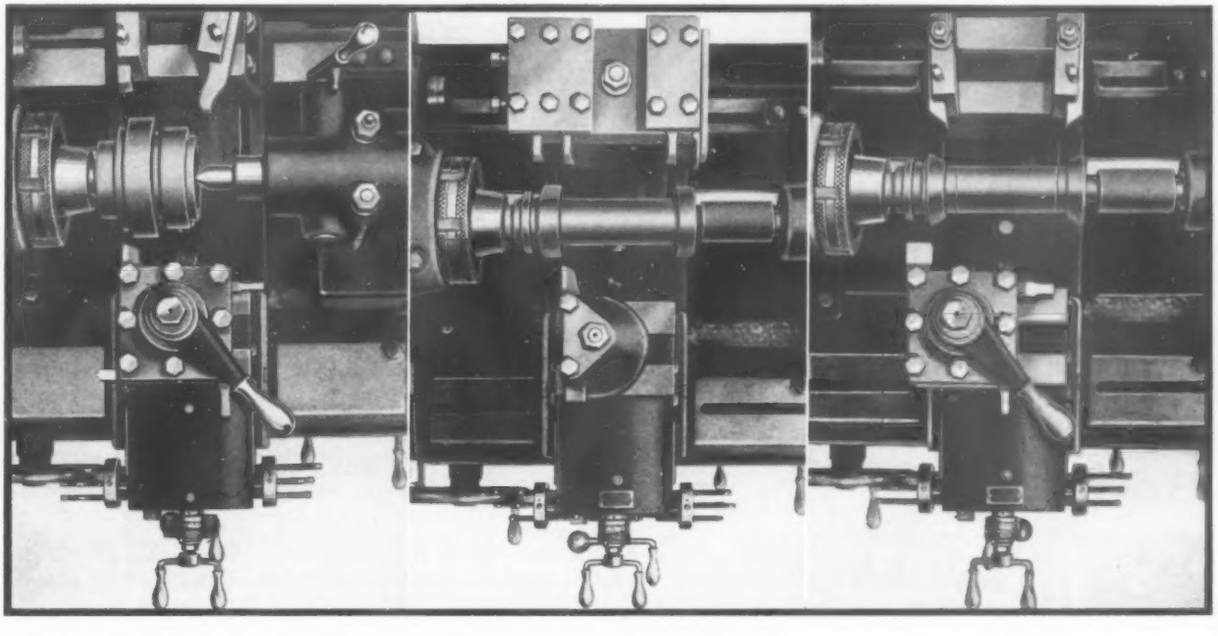


Lodge & Shipley 16" Selective Head Manufacturing Lathe.

Machining a cluster gear mounted on an arbor driven from the taper hole in spindle. Four-way Tool Block in front, two gang tool blocks in rear.

First operation on a double bevel gear using special tool blocks on the Connected Rear Rest in combination with the High Duty Tool Block on the Compound Rest.

Second operation on double bevel gear, two bevels being formed in one operation using special forming tools in Swivel Tool Holders on the Connected Rear Rest.



This machine speaks in terms of

TIME is unquestionably one of the Nation's most important factors, and to accomplish more in less time is the task confronting all industry today. Our entire defense program, in fact, our very existence, may be contingent upon how much we are able to accomplish within the next few years.

The CINCINNATI High-Speed Dial Type Milling Machine has been developed to its present high degree of efficiency to produce two milling jobs where only one was produced before, and to do it with greater accuracy and less operator fatigue. A study of the illustration above will convince you that CINCINNATI High-Speed Dial Type Milling Machines are built to "Speak in Terms of Performance." Case histories in all types of industry and from all parts of the world bear out this performance story — in some instances saving as much as 50% over previous methods.

CINCINNATI Dial Type Milling Machines are available in Plain, Universal and Vertical Types in three sizes, No. 2, 3, 4, and in either of two speed ranges, Medium or High.

May we tell you more about the capabilities of these machines? Specification folder M-868 covering full information on all features and their benefits, will be sent on request. Send for your copy today.

CINCINNATI

SAVE *with a Cincinnati!*

PERFORMANCE

PRODUCTIVITY. Demands for increased production in the aviation industry have never been greater. On the CINCINNATI High-Speed Dial Type pictured above, the operator is face milling ends and sides of an upper station airplane truss. Complete rear controls permit full view of cutters and work.

FASTER HANDLING with rear hand adjustments for cross and vertical power feeds. Pull-out quick adjusting micrometer dials eliminate the necessity of adding or subtracting mentally when adjusting the work to the cutter.

FASTER SET-UP - - easy to remove or replace arbor supports when changing cutters and arbors. Overarm and supports clamp tightly against a solid dovetail locating side in straight-edge alignment; no twisting; no permanent set.

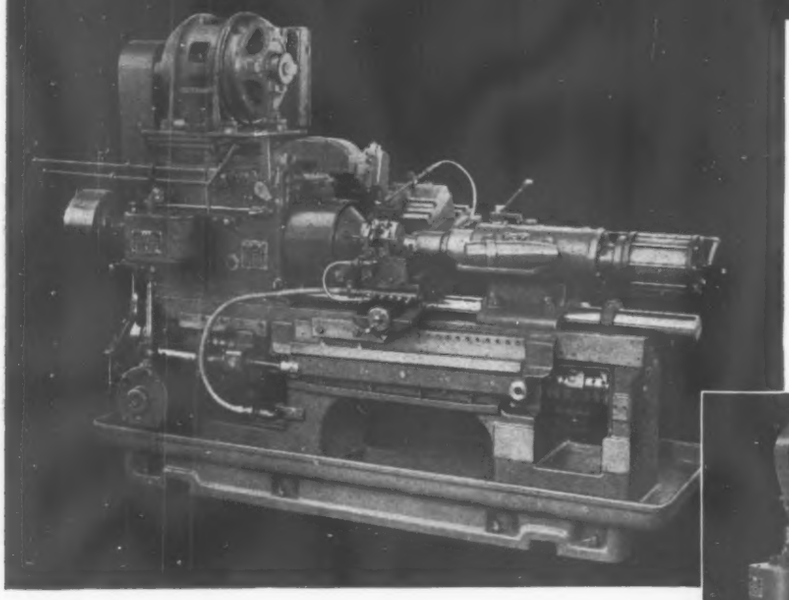
ACCURACY. The most important consideration in the building of machine tools is accuracy. Here a CINCINNATI High-Speed Dial Type is milling slots in threading die for an automatic screw machine. On this job accuracy was improved, production increased 100% while grinding stock was reduced 50%.

THE CINCINNATI MILLING MACHINE CO.

Cincinnati, Ohio U. S. A.

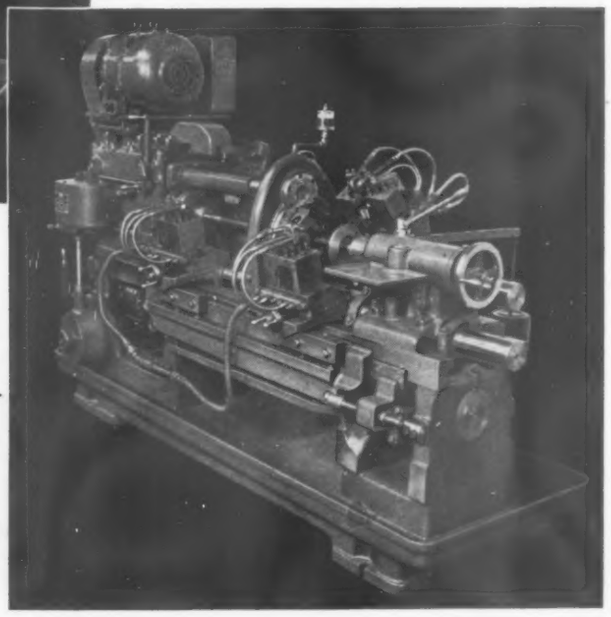
TOOL ROOM AND MANUFACTURING MILLING MACHINES
SURFACE BROACHING MACHINES • CUTTER SHARPENING MACHINES

THE TIME WILL COME



←——**SHELLS**

Jones & Lamson 12" Fay Automatic Lathe machining the copper band of a 90-mm. shell.



AXLE SHAFTS——→

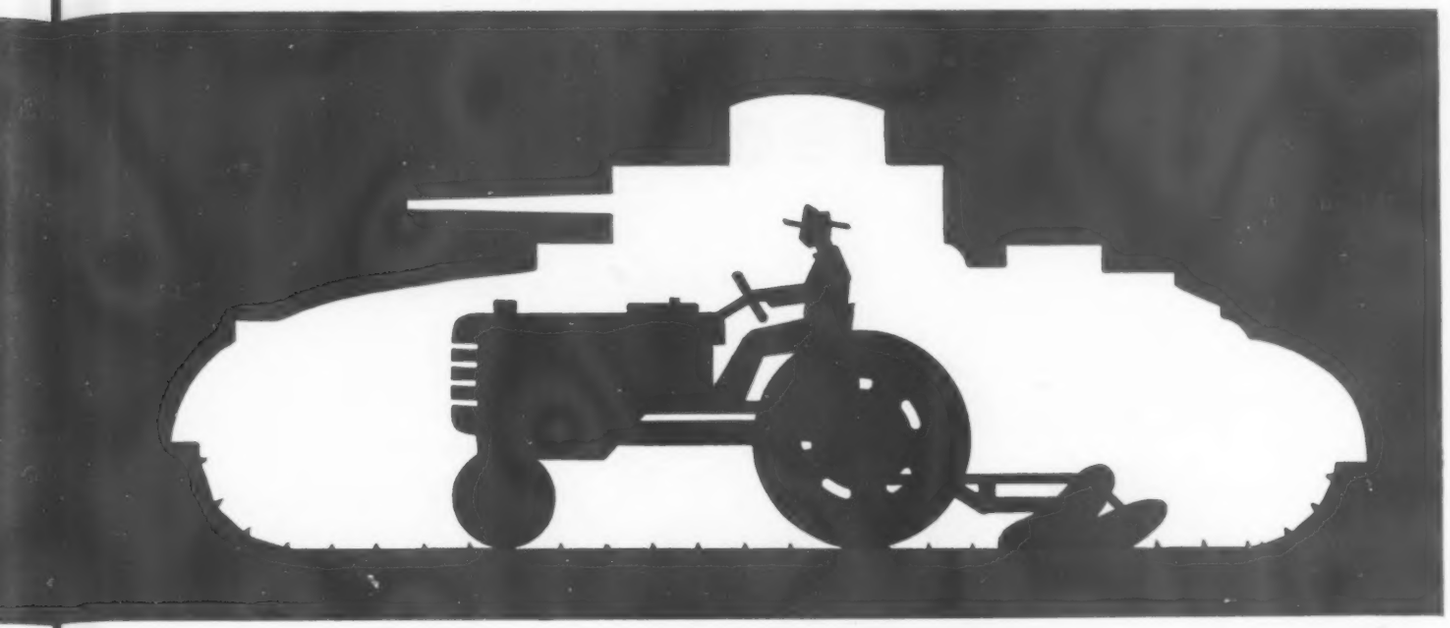
Jones & Lamson 12" Fay Automatic Lathe machining an axle shaft.

J&L

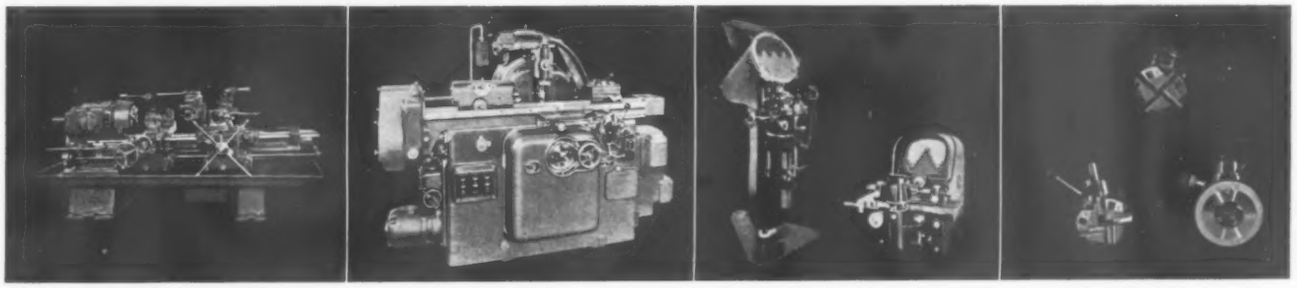
JONES & LAMSON

SPRINGFIELD, VERMONT, U. S. A.

PROFIT PRODUCING MACHINE TOOLS



. . . . When, at last, the firing ceases and the nations turn from armament to commerce, will you be better prepared for peace than you were for defense? Costly special purpose machines will only be liabilities then. Long-lived, versatile, standard Jones & Lamson equipment will speed defense today, and protect your peace time earnings in the years to come.



RAM & SADDLE TYPE UNIVERSAL TURRET LATHES

AUTOMATIC THREAD GRINDERS

OPTICAL COMPARATORS

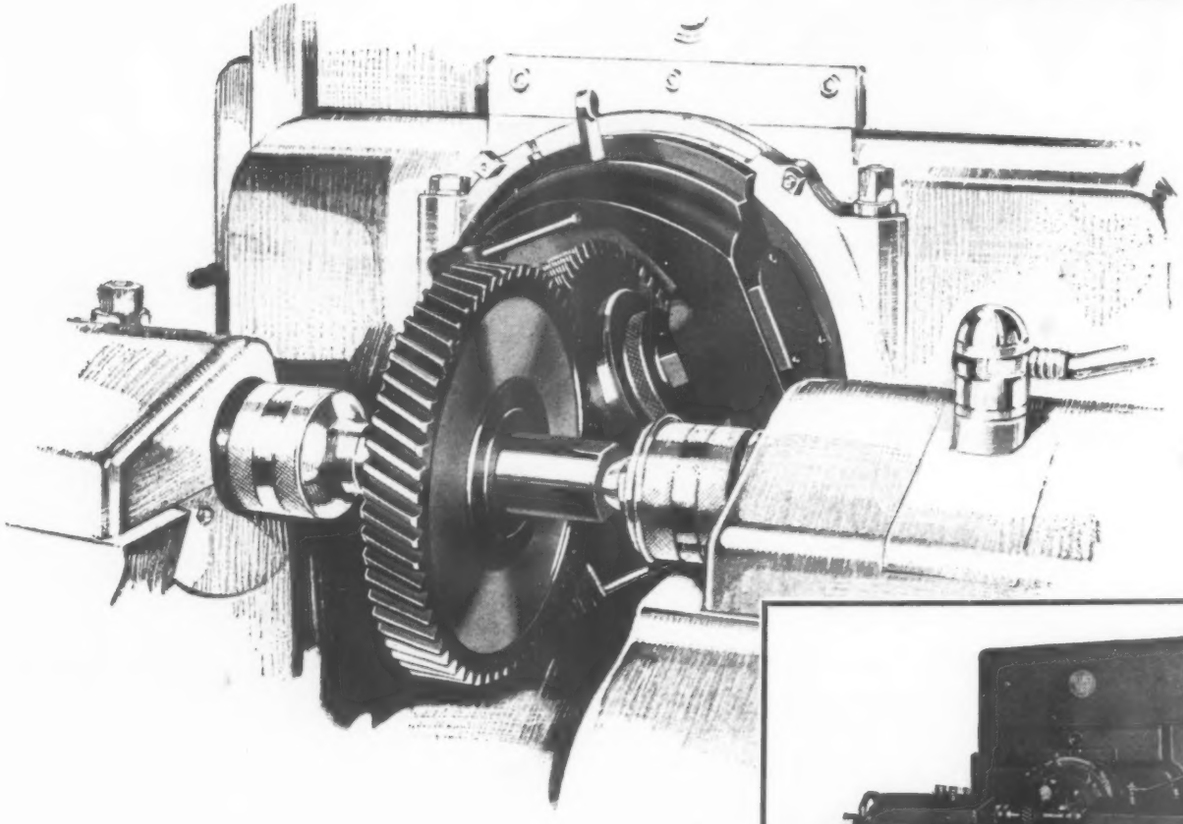
AUTOMATIC OPENING DIE HEADS

MACHINE COMPANY

MANUFACTURERS OF SADDLE & RAM TYPE UNIVERSAL TURRET LATHES . . . FAY AUTOMATIC LATHES . . . AUTOMATIC DOUBLE-END MILLING & CENTERING MACHINES . . . AUTOMATIC THREAD GRINDING MACHINES . . . COMPARATORS . . . TANGENT AND RADIAL, STATIONARY AND REVOLVING DIES AND CHASERS

THIS Gear Finishing

EMBODIES



No. 18 Fellows Gear Finishing Machine for Spur and Helical Gears up to 18" pitch diameter, 5" face width.

FELLOWS

MACHINES AND TOOLS FOR GEAR PRODUCTION

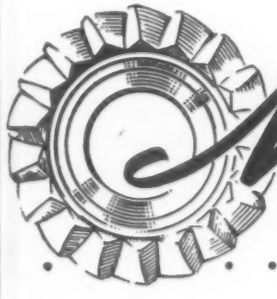
Machine

A FUNDAMENTAL *Fellows* CONCEPT

FOR almost half a century Fellows has been making precision tools and manufacturing equipment for accurate gear production. This extensive experience has conclusively demonstrated that rigidity is of paramount importance where limits in the tenths of a thousandth of an inch must be maintained.

In designing the Fellows Gear Finishing Machine, extreme RIGIDITY was the first consideration. That this requirement was amply met is attested by the success that this machine has attained under present day high-production pressure. Sustained precision is a fundamental concept of the Fellows Method. It takes time, money and experience to build plus-quality in Fellows Machines and tools—a quality for which Fellows is justly famous.

Our 64-page catalog "The Fellows Method" explains the successful applications of this vital concept to gear production. THE FELLOWS GEAR SHAPER COMPANY, Springfield, Vermont, U.S.A. —Branch Offices: 616 Fisher Building, Detroit, Michigan —640 West Town Office Building, Chicago, Illinois.



Method

. . . . . FROM BLANK TO FINISHED GEAR

FASTER-

Built by master craftsmen who have a thorough knowledge and understanding of the problems and requirements of tool room grinding, many time- and effort-saving features have been incorporated in the CINCINNATI 12″ Hydraulic Universal Grinding Machine. The last word in a tool room grinder, this hydraulic universal grinding machine makes possible extreme accuracy, easily achieved; faster handling, set-up and sizing, while maintenance costs are cut almost to the vanishing point.

Skill is actually built into this grinder. Conveniently located controls make operation a comparatively simple procedure and enable new men to quickly get the feel of the machine. External and internal grinding from the same chucking, FILMATIC bearings which practically eliminate spindle flutter, sensitive, precise and positive controls, conveniently located, are but a few of the important features which make the CINCINNATI 12″ Hydraulic Universal Grinding Machine the ideal grinder for your tool room.

R-SET-UP!

FASTER-HANDLING!

FASTER-SIZING!

GRINDING

CINCINNATI

SAVE *with a Cincinnati!*

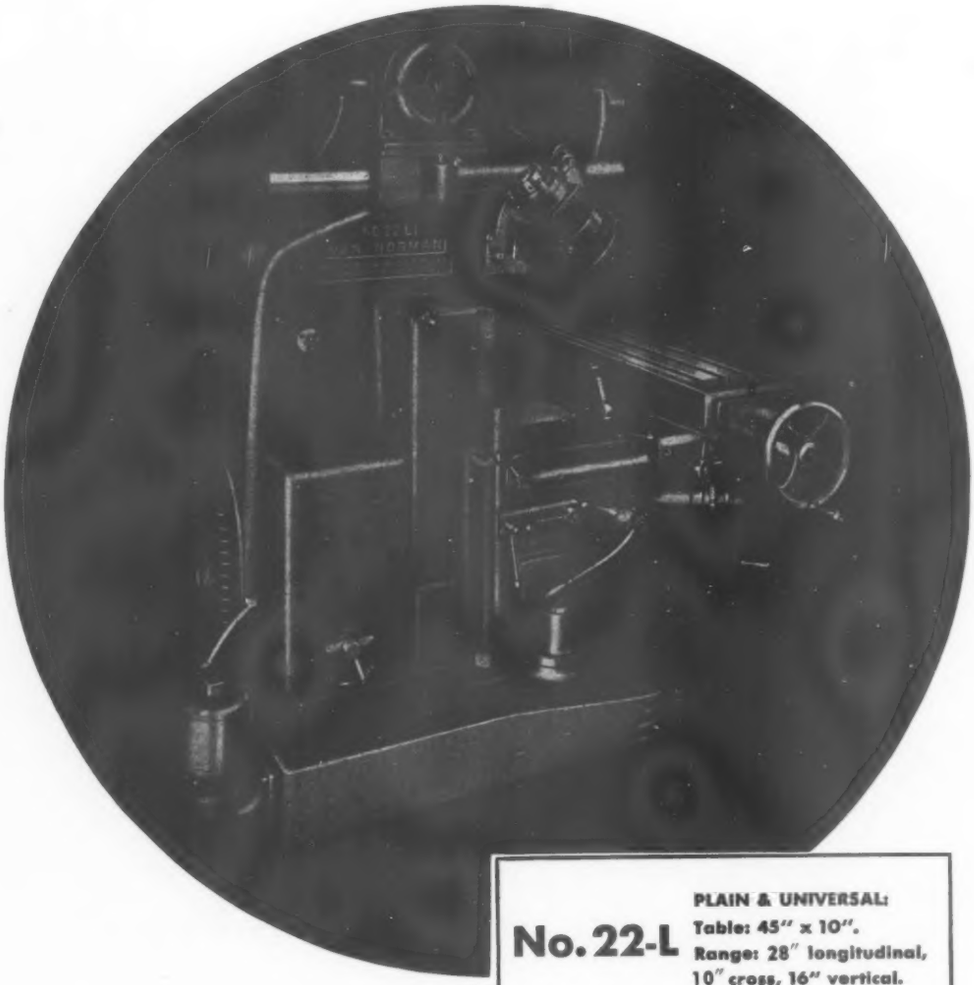
At left: A CINCINNATI 12" x 48" Hydraulic Universal at work in a tool room grinding a steep taper of 3½" per foot. Maximum swivel range of table has been accomplished by reducing bulge of spindle housing in front of spindle, and by the unusual design of tailstock. Rigidity has not been sacrificed.

Better Grinding In Your Tool Room, a 16-page and cover brochure, fully illustrated, giving complete information on all features and advantages of the CINCINNATI 12" Hydraulic Universal Grinding Machine, is yours for the asking. You will be interested in this informative book.

CINCINNATI GRINDERS INCORPORATED

Cincinnati, Ohio U. S. A.

CENTER TYPE GRINDING MACHINES • CENTERLESS GRINDING MACHINES
CENTERLESS LAPPING MACHINES



No. 22-L **PLAIN & UNIVERSAL:**
Table: 45" x 10".
Range: 28" longitudinal, 10" cross, 16" vertical.

VAN NORMAN MI

INCREASE BOTH OUTPUT AND QUALITY on toolroom, contract, pattern, experimental and small-lot production work . . . with Van Norman Ram Type Universal Millers. The adjustments of swiveling cutterhead and sliding ram make it easy and convenient to mill vertical, horizontal, and angular surfaces...without attachments and with fewest reset-ups. There are many other important features: New streamlined column . . . directional front and rear controls of power feeds . . . 6-way rapid traverse for the new and improved table, knee and saddle . . . large dials . . . wide speed and feed selection . . . and greater rigidity. For a full picture of all the details provided in the new models of Van Norman Ram Type Universal Millers . . . write for illustrated bulletins.

VAN NORMAN MACHINE TOOL CO., SPRINGFIELD, MASS.

LLING MACHINES

A 3-BEARING SPINDLE

in "AMERICAN" Pacemaker Lathes

For greater rigidity, longer life and smoother operation

The three bearing spindle is unquestionably the stiffest spindle construction used in lathe design. An intermediate or center bearing provides support at the very point where it is needed most, resulting in the complete elimination of deflection under heavy service.

This rigid spindle mounting insures long life for the driving gears, together with smooth and quiet operation at all speeds and under the heaviest service.

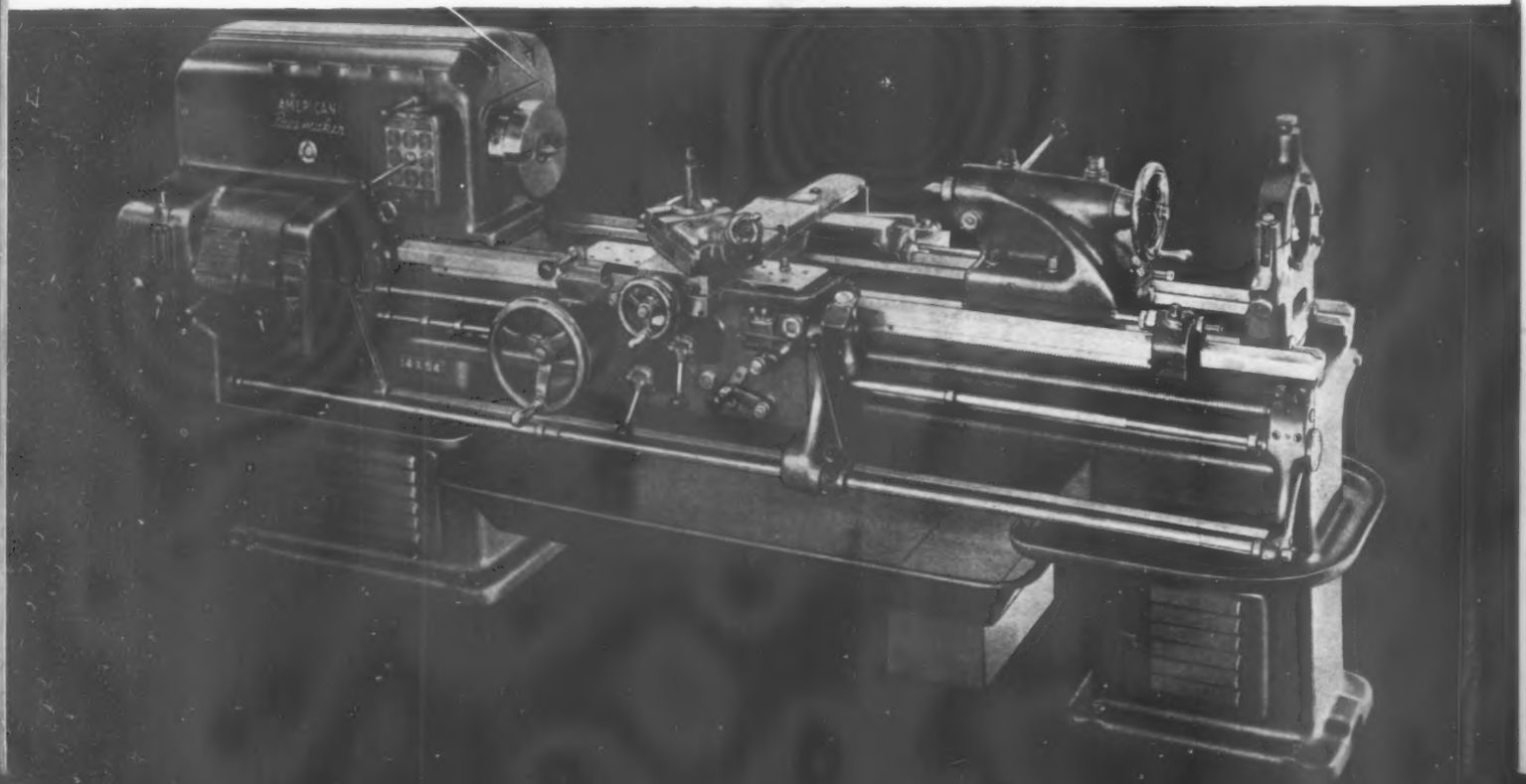
In this three bearing "AMERICAN" construction a rear bearing of the floating type is used which provides for spindle expansion resulting from temperature rise.

Bulletin 15 illustrates the many new and outstanding characteristics of the "American" Pacemaker Lathe.

THE AMERICAN TOOL WORKS COMPANY

LATHES • RADIALS • SHAPERS

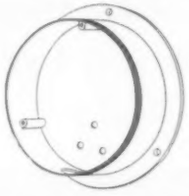
CINCINNATI, OHIO, U. S. A.



Three Distinct Types of "Bakelite" Plastics Improve Durability, Efficiency, and Appearance

OF NEW ASHCROFT AMERICAN DURAGAUGE

Cover is molded from BAKELITE Polystyrene, because it is tougher than glass and provides more "open face" for greater visibility.



Housing is molded from a sturdy BAKELITE Phenolic, because it is lighter than metal and also resists corrosion.

Dial is fabricated from BAKELITE Laminated Sheet Stock, because figures can be indelibly incorporated in the material.

THE MANNING, MAXWELL & MOORE, INC. "DURAGAUGE" graphically demonstrates the many ways in which BAKELITE Plastics in their various forms contribute to instrument durability, efficiency, and appearance.

Transparent BAKELITE Polystyrene is employed for the cover because it combines crystal clarity with dimensional stability and resistance to shattering. It makes possible the threaded, "streamlined" design which eliminates a threaded ring, gasket and retainer ring assembly, formerly necessary with glass.

BAKELITE Phenolic Molding Material replaced metal for the gauge housing, because of its light weight, sturdiness, and resistance to corrosion.

BAKELITE Laminated Sheet Stock serves ideally for the dial, since it will not warp. In addition, it enables the printed numerals to be incorporated as a basic part of the material itself. Thus, legibility is never impaired by use or cleaning.

For complete information on these materials and other types of BAKELITE Plastics, write for illustrated booklet 2M, "Bakelite Molding Plastics".

BAKELITE CORPORATION, 30 East 42nd Street, New York

Unit of Union Carbide and Carbon Corporation

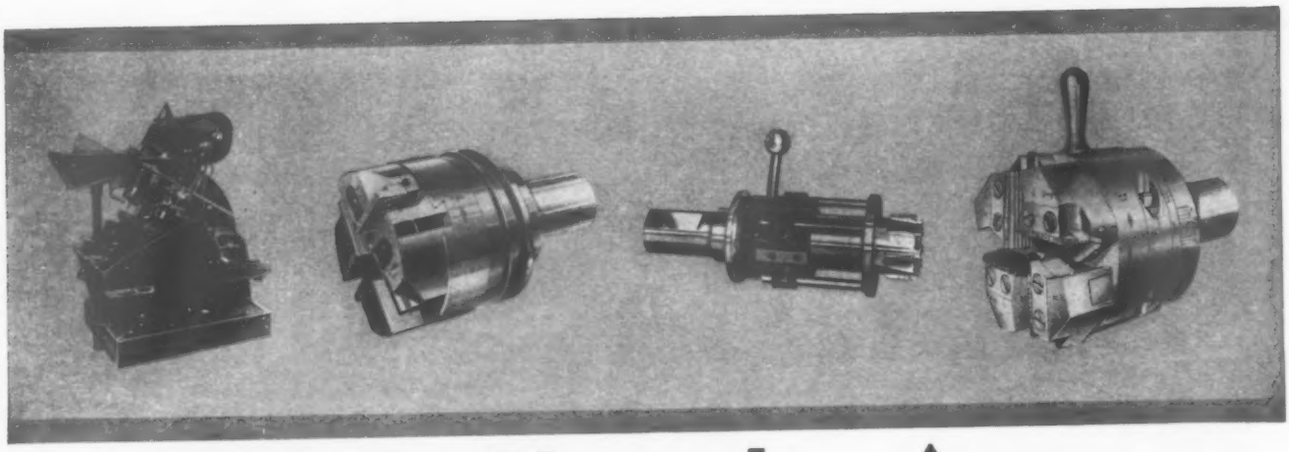
UCC

BAKELITE

TRADE MARK

The word "Bakelite" and the design identifying products are registered trade-marks of Bakelite Corporation

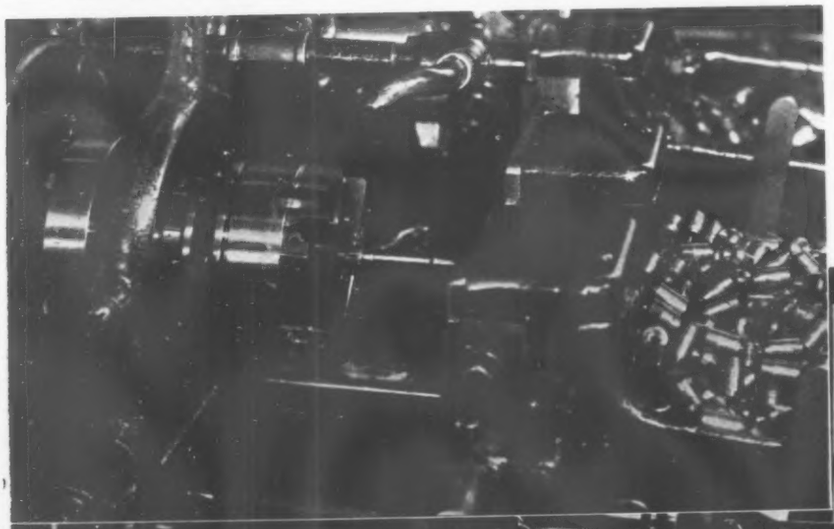
PLASTICS HEADQUARTERS

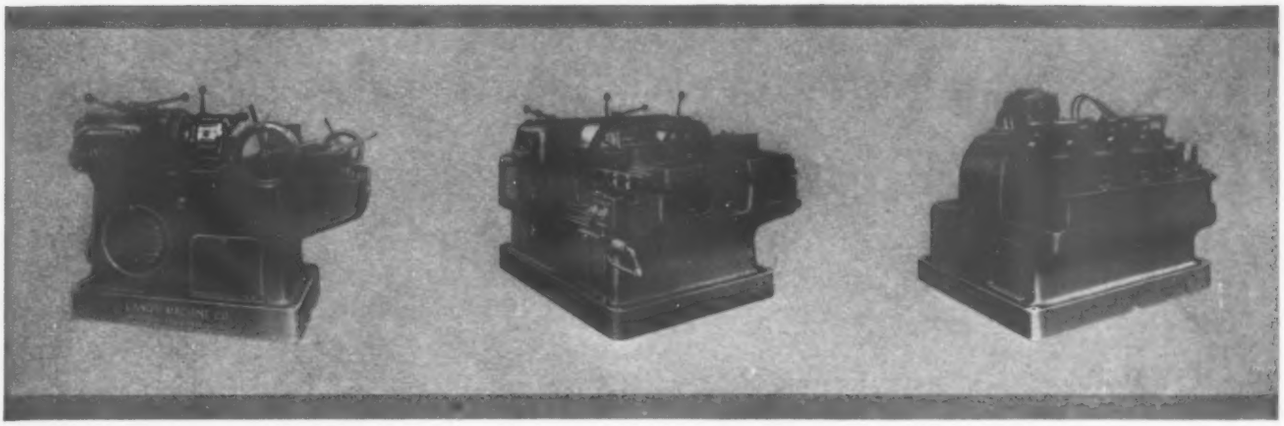


LANCO Heads Assure

BE THREADWISE

LANDISize for Higher Production at Lower Cost





Low Threading Cost

The set screws which are threaded on the LANDMACO Threading Machine equipped with LANCO type V Heads, illustrated—range from 1/4" diameter to 1 1/4" diameter. The screws are all made from 3140 S.A.E. coldworked bar steel.

Threading at a cutting speed which ranges from 72 R.P.M. to 392 R.P.M., depending upon the diameter which is being threaded an average of 250 screws, Class No. 3 fit, are threaded per hour. The average run between grinds of the chasers is 10000 screws.

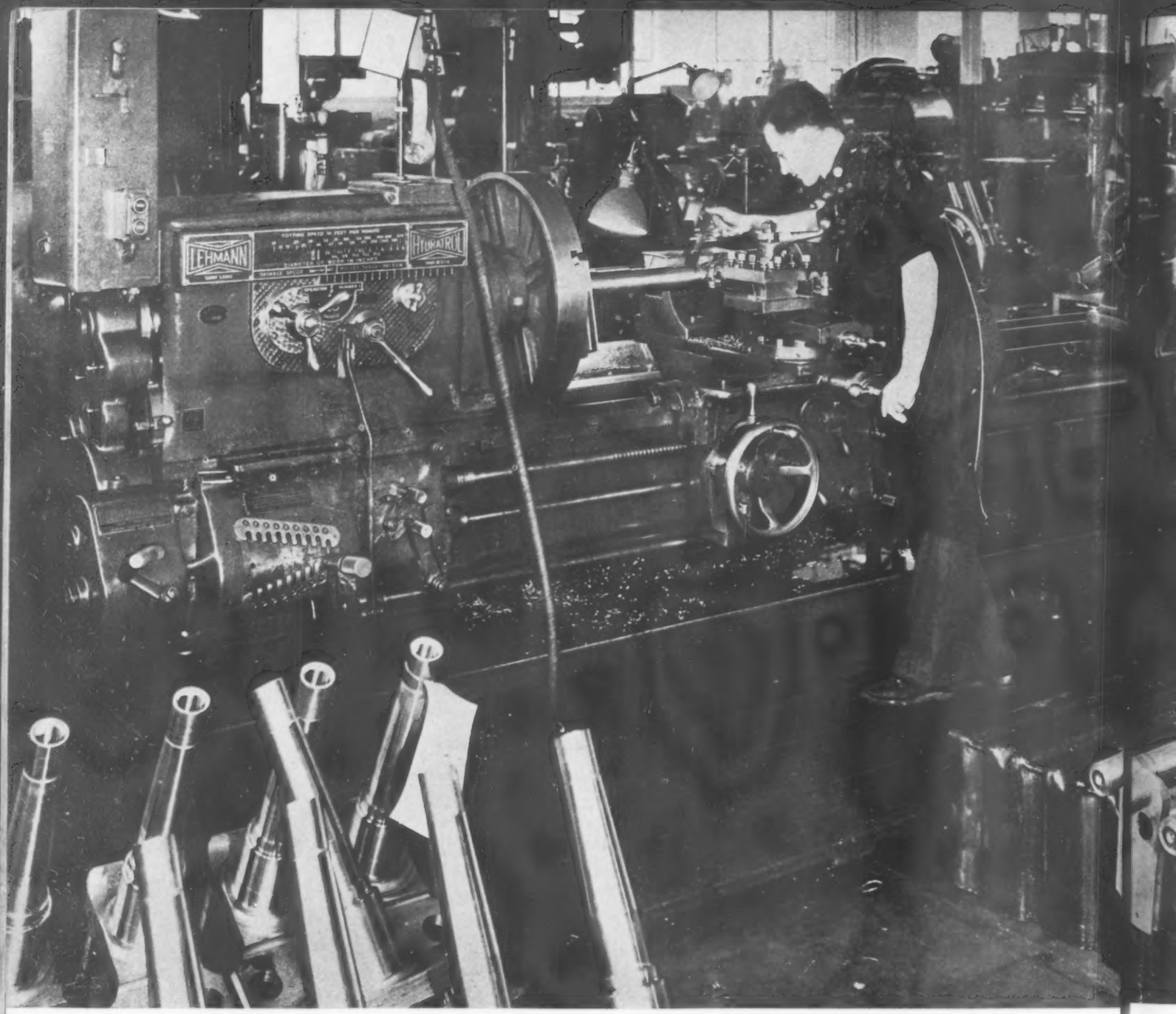
Such performance leaves but one conclusion THREADING Cost must be low.

Investigate the advantages of using LANCO Heads for handling your threading operations. Write for our Bulletin No. F-80 today.

The LANDIS Line

STANDARD THREADING MACHINES
LANDMACO THREADING MACHINES
BOLT FACTORY THREADERS
AUTOMATIC FORMING AND THREADING MACHINES
PIPE THREADING AND CUTTING MACHINES
PIPE AND NIPPLE THREADING MACHINES
ROLLER PIPE CUTTERS
CHASER GRINDERS
ROTARY BOLT THREADING DIE HEADS
STATIONARY PIPE DIE HEADS
LANDMATIC HEADS FOR TURRET LATHES
LANDEX HEADS FOR AUTOMATIC SCREW MACHINES
LANCO HEADS FOR HAND-OPERATED THREADING MACHINES
LANDIS COLLAPSIBLE AND ADJUSTABLE TAPS

LANDIS MACHINE COMPANY, Waynesboro Pennsylvania



Air Craft Engine CRANK SHAFTS
BEING MACHINED ON HYDRATROL LATHES AT THE WRIGHT AERONAUTICAL COMPANY'S PLANT.

- ease, speed, and simplicity of operation
- unequalled capacity for power transmission
- freedom from stoppage for adjustments
- absence of mechanical troubles
- automatic presentation of essential information
- automatic and ample lubrication
- extraordinary hardness of bed

Many HYDRATROL LATHES are in the service of this company. Pictured here is a HYDRATROL 20" LATHE machining crank shafts of SAE X-4340 material heat treated to Brinnell 290-321. Tolerances on each operation .002".

The SLIDE RULE calculates, indicates, and makes available instantly, any one of 16 spindle speeds by a single turn of the operating handle.

•

WRIGHT AERONAUTICAL COMPANY
ARE USERS OF
HYDRATROL LATHES . . .

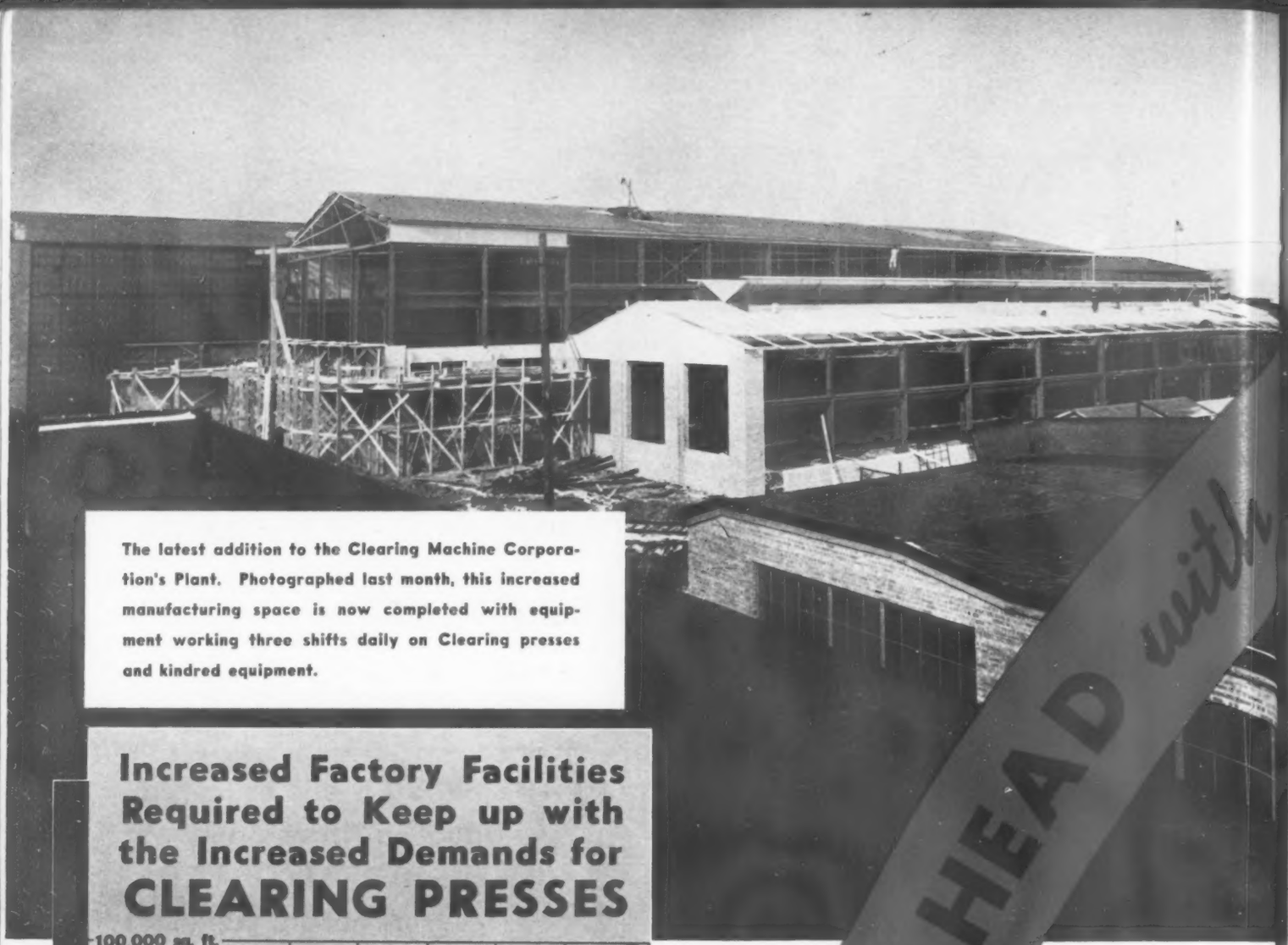
SPEED is one of the production advantages of the HYDRATROL LATHE —users not only find that this modern lathe helps speed up schedules but also performs with highest quality results at important savings in cost.

The HYDRATROL LATHE offers tremendous capacity for high power requirements: operating simplicity through mechanism which automatically changes speeds, indicates cutting speed of the work in feet per minute, and provides pre-determined setting for numbered operations. Automatic control assures safety of positive engaging members.

Get all the facts on simplifying your present lathe problems, on speeding up production, and on increasing savings with a Lehmann HYDRATROL LATHE.

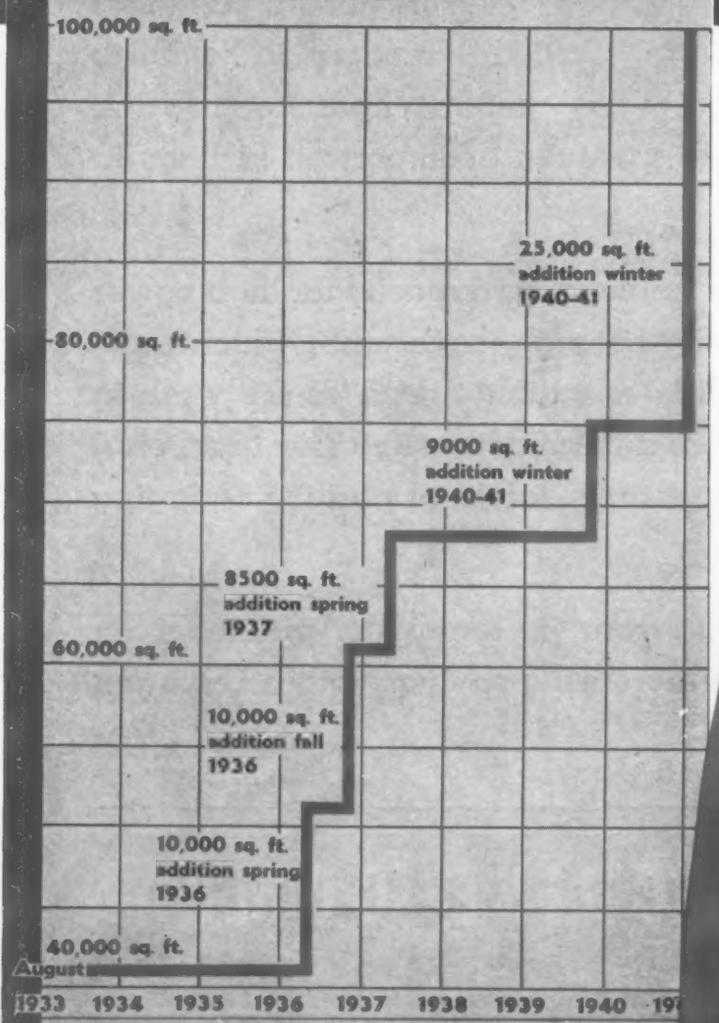
Lehmann MACHINE COMPANY

CHOUTEAU AT GRAND ST. LOUIS, MISSOURI



The latest addition to the Clearing Machine Corporation's Plant. Photographed last month, this increased manufacturing space is now completed with equipment working three shifts daily on Clearing presses and kindred equipment.

Increased Factory Facilities Required to Keep up with the Increased Demands for CLEARING PRESSES


100,000 sq. ft.
80,000 sq. ft.
60,000 sq. ft.
40,000 sq. ft.
25,000 sq. ft. addition winter 1940-41
9000 sq. ft. addition winter 1940-41
8500 sq. ft. addition spring 1937
10,000 sq. ft. addition fall 1936
10,000 sq. ft. addition spring 1936
August
1933 1934 1935 1936 1937 1938 1939 1940

FULL SPEED AHEAD with

CLEARING

CLEARING MA

CLEARING PRESSES!

That industry in general has placed its stamp of complete approval on CLEARING PRESSES is demonstrated in the most significant way possible: *the expansion of the facilities required to build them!*

The step by step growth of CLEARING is clearly shown by the illustrations on these pages. First a plant of moderate capacity, but with complete facilities in every department. Next, as CLEARING PRESSES proved their worth, an addition was made to meet the increased demand. CLEARING PRESSES at this point were showing production men a new high mark in press performance; their efficiency was becoming a standard of comparison.

And again, on the basis of performance and production figures CLEARING PRESSES were replacing obsolete press methods in so many shops that increased manufacturing facilities were once more a necessity. And so CLEARING has progressed. Step after step in plant expansion has taken place, as more and more manufacturers have recognized the superiorities of CLEARING performance, until today CLEARING has one of the world's most complete plants for the manufacture of presses!

CLEARING engineering facilities are equipped to handle any press problem; and it usually finds a solution which means dollars and cents savings on specific jobs.

If it's press work—*Full Speed Ahead With CLEARING.*

CHINE CORPORATION **CHICAGO and DETROIT**

A Cleveland Two Point Press being used in the production of side rail blanks for Automobile frames.

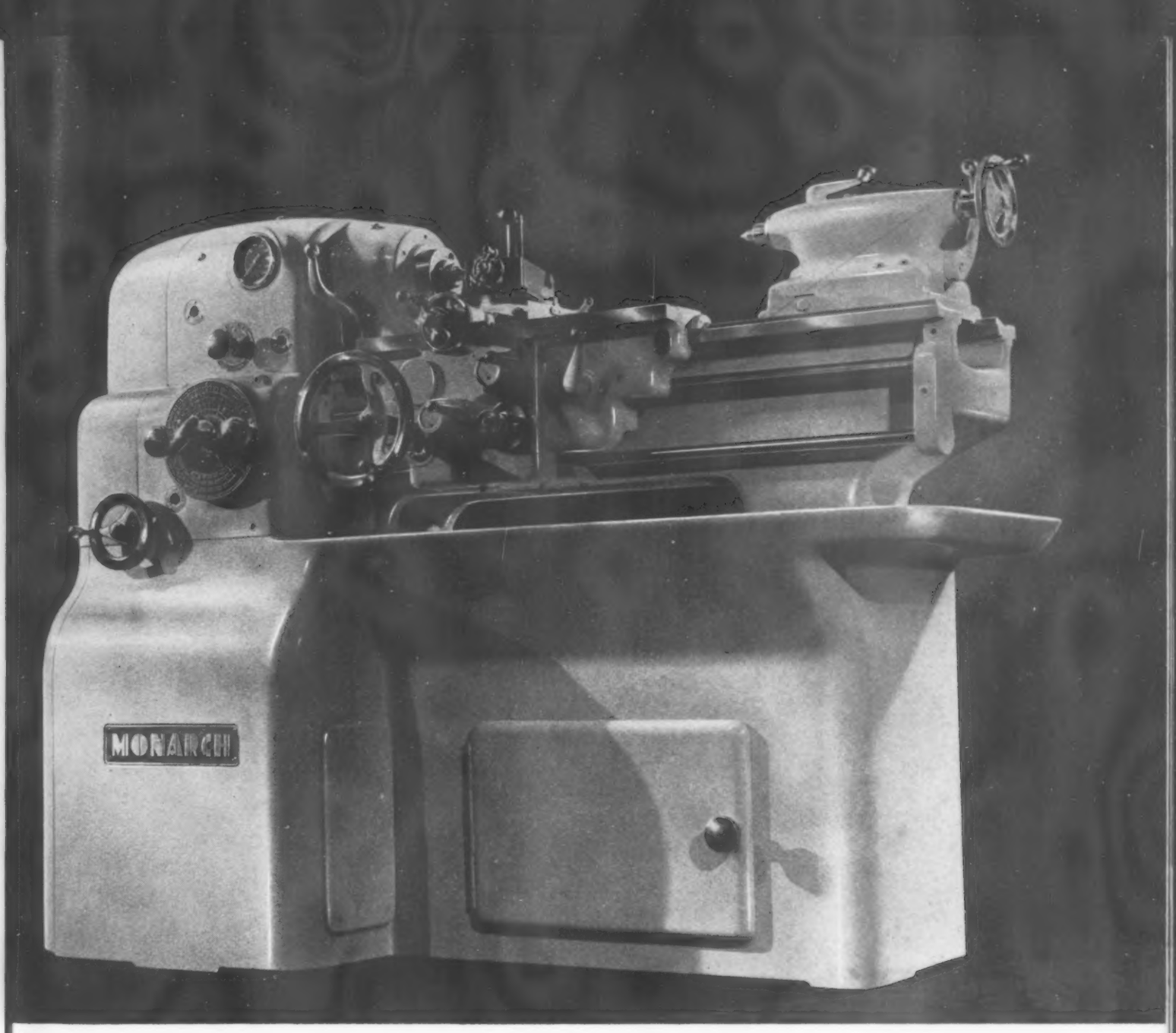
The Press measures 156" between the uprights, exerts a pressure of 750 tons and is equipped with an electrically controlled air friction clutch and brake.

The Press is symmetrical front and back except for the opening in the crown which permits easy removal of the drive unit and gearing where there is a limited amount of head-room.

Cleveland Two Point Presses can be furnished in sizes and capacities to suit particular requirements.

Modern Presses — the key to production

Modern Presses THE CLEVELAND PUNCH & SHEAR WORKS COMPANY *Cleveland, Ohio*



The Monarch 10″ x 20″ Sensitive Precision Tool Maker's Lathe

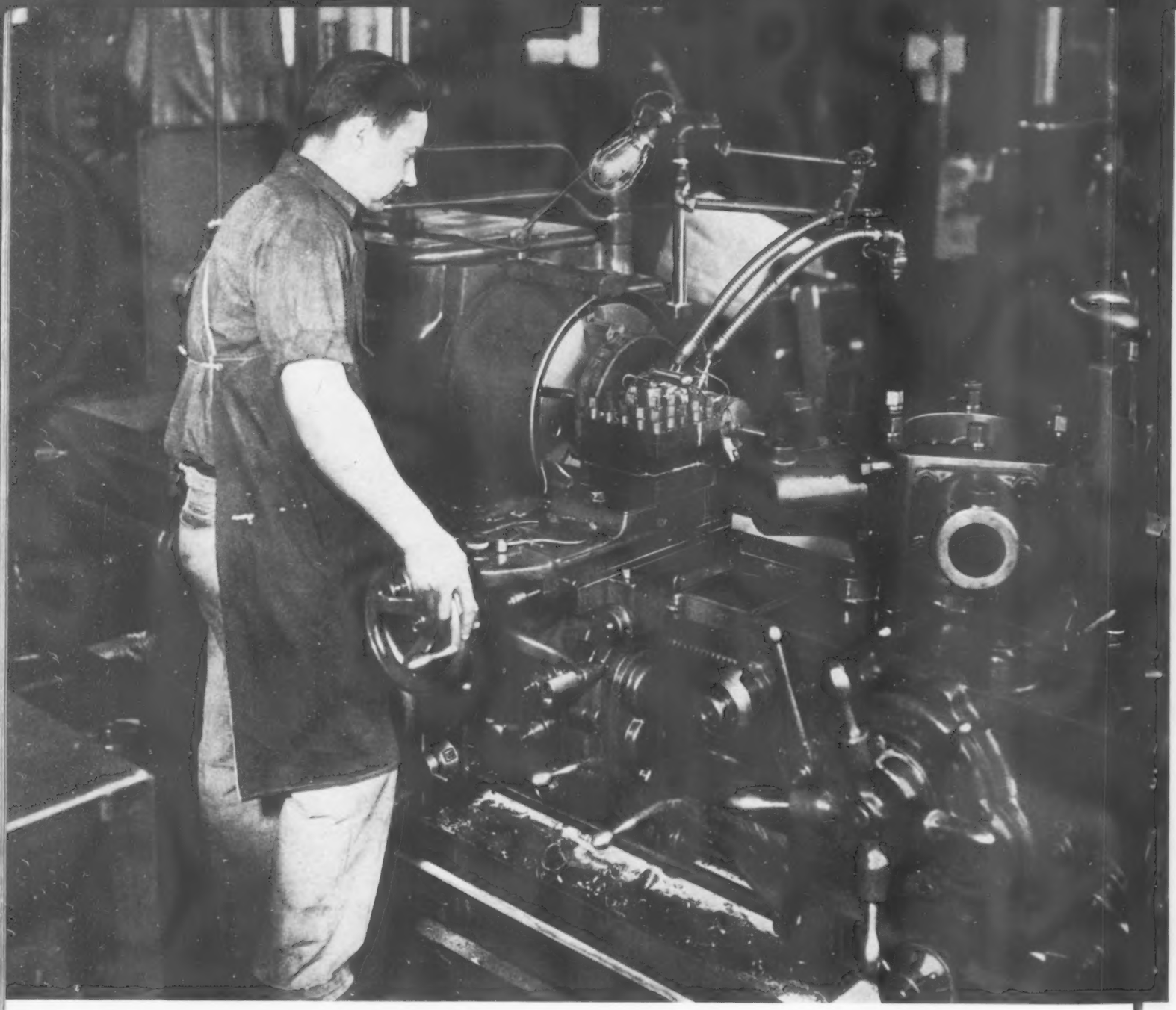
TAKING its place in the front ranks of the National Defense drive, this Monarch Lathe is doing a magnificent job in the making of tools and gauges, vital to the success of America's Defense program.

Equipped with a 3 HP drive unit, the 10″ x 20″ Sensitive Precision Lathe provides, electrically, a stepless spindle speed range from 6 RPM to 2500 RPM. This range can be increased up to a maximum of 5000 RPM.

These lathes are now being delivered in large quantities to tool and gauge making plants as well as to tool rooms of most National Defense contractors, including the various government establishments. The Monarch Machine Tool Company, Sidney, Ohio.

MONARCH LATHES
COVER THE TURNING FIELD
SIDNEY... OHIO, U.S.A.

Chicago Sales Office: 622 West Washington Boulevard • Indianapolis Sales Office: 3115 North Meridian Street • Newark Sales Office: 1060 Broad Street • Pittsburgh Sales Office: 604 Chamber of Commerce Building • *Agencies in principal industrial centers of this and foreign countries*



Libby TURRET LATHES

★ The operations performed by Logansport Machine Co., Inc. in machining shell mandrel bodies are Turn O. D. and Face tolerances, +.005 and Bore, tolerances .005. The material is 15-25 Carbon Steel Forging. The Libby H Type seen in the picture has been in service 10 months.

★ Let us discuss your requirements with you and show you how a Libby Turret Lathe can fit into your operating requirements for higher quality, faster, and more economical results. Libby sales engineers are available for conference at your convenience.

235.0 HOURS PER HUNDRED

Saved IN MACHINING

SHELL MANDREL BODIES

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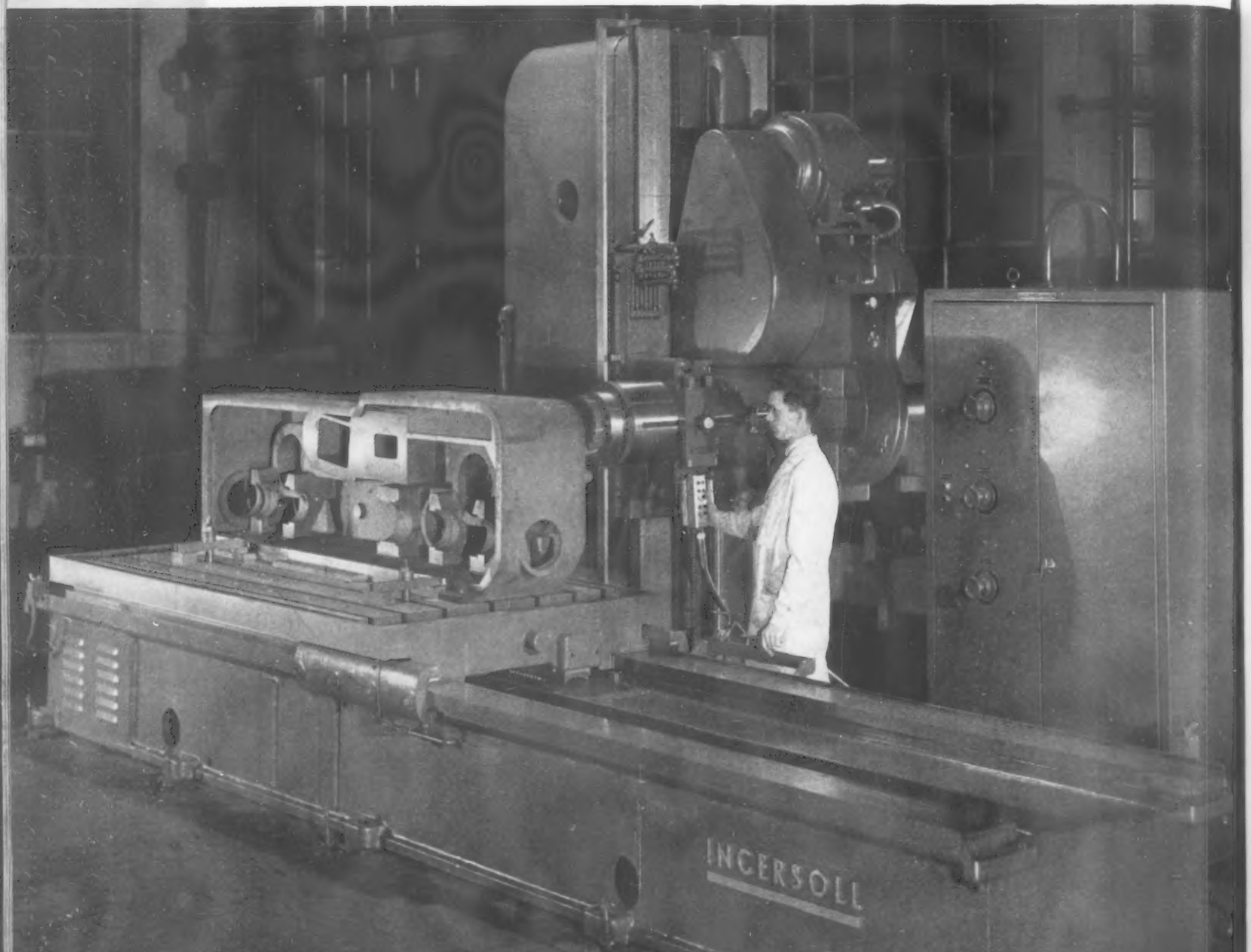
Libby Turret Lathes are built with strength sufficient to really withstand continuous heavy duty operation. More than that, they are designed to take work even over their rated capacities and get the most out of new high-speed cutting tools.

INTERNATIONAL MACHINE TOOL CORPORATION
LIBBY DIVISION
Indianapolis, Indiana

★Libby Type H in the service of Le Blond Engineering Co., Cincinnati, Ohio, machining lathe parts of cast iron and steel. The operations performed are BORING — TURNING CHASE and REAMING. The tolerances of each operation .0005.

A *New* MACHINE A



MACHINE DATA

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COLUMN — Sturdy box-type construction, 30″ wide x 48″ deep. Height permits 5′ vertical travel of the head.

HEAD — A 15 h.p. direct motor driven milling and boring head, having 5′ vertical feed and traverse.

SPINDLE AND QUILL — A 13⅞″ diameter quill carries and supports the spindle. It has a 20″ lateral feed and traverse by power and hand.

SPINDLE SPEEDS — From approximately 3 to 80 R.P.M. easily obtainable.

FEEDS — The table has an independent feed range of ¼″ to 12″ per minute. The head and quill feeds are obtained thru another feed system independent of table feed. Head feeds range from ¼″ to 12″ . . . Quill feed is from 3/32″ to 4″. Traverse rates for the table, head, and quill are 15′, 9′, and 3′ per minute respectively.

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CONTROL — From electric push buttons in a Portable Pendant and 3 rheostats convenient to operator's hand.

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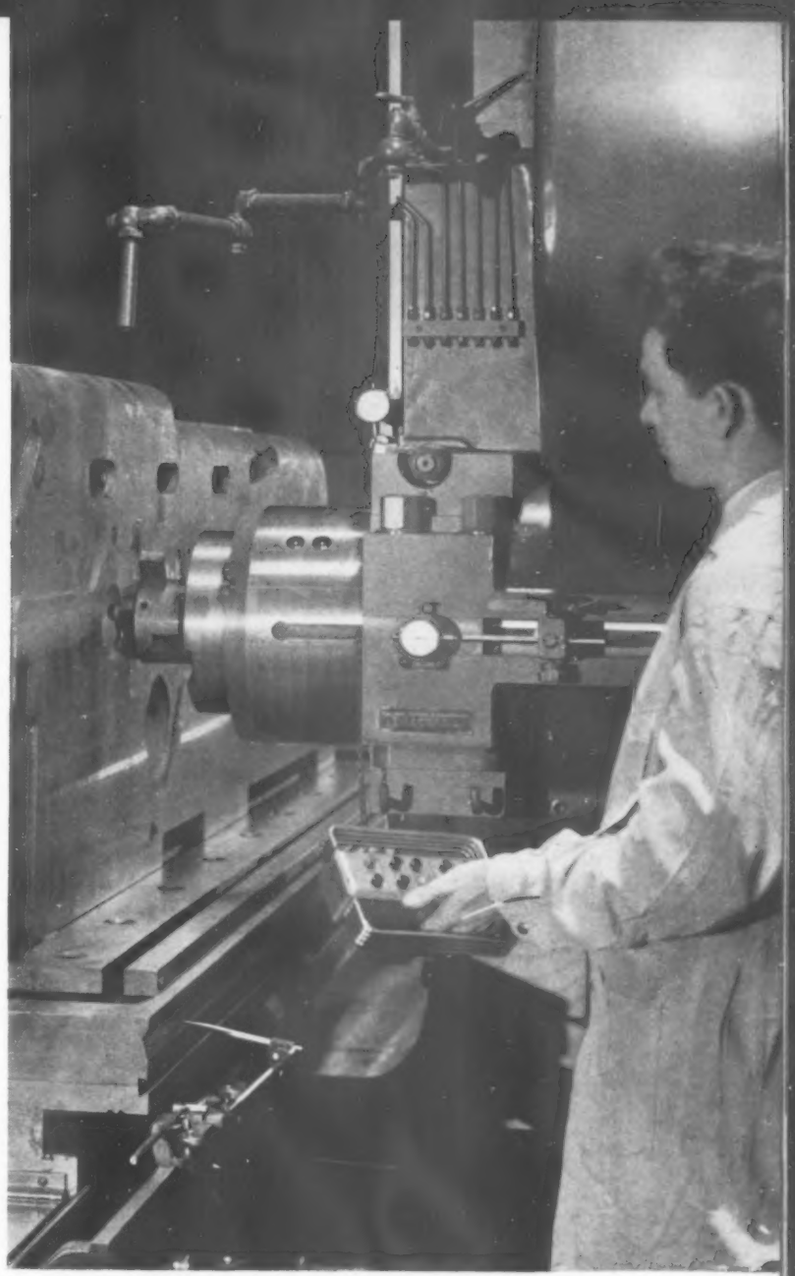
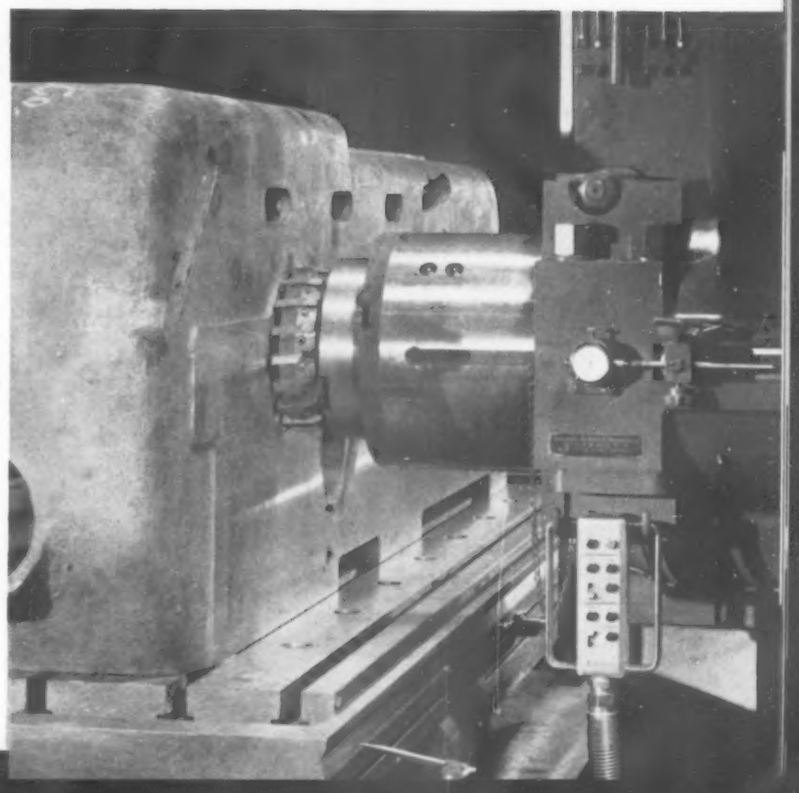
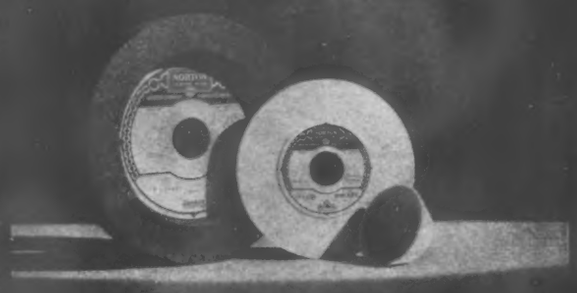


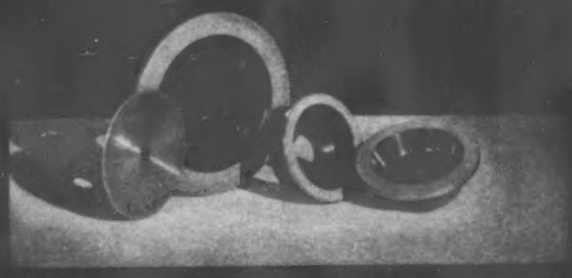


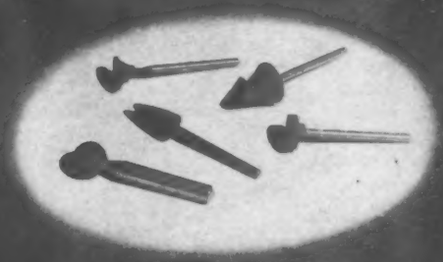
THE INGERSOLL MILLING MACHINE CO.

ROCKFORD, ILLINOIS

TOOL ENGINEERS







. . . *Let Norton Share Your Grinding Worries*

There's no time now in the tool engineer's day for details such as tool sharpening. But near you there is a Norton engineer ready to tackle the grinding jobs.

High Speed Steel Tools —

For grinding high speed tool steels and similar alloys the Norton engineer will recommend the special "B-E" bond and one of the Norton fused alumina abrasives—Alundum, 19 Alundum, 38 Alundum or 57 Alundum. Grain, grade and structure selection will depend on the details of each job.

Cemented Carbide Tools —

For off-hand grinding of single point cemented carbide tools he will recommend the Norton developed metal bonded diamond wheel—strong, heat-resistant and extremely long lived. For tool and cutter grinding of multi-blade carbide tools it will be the fast cutting resinoid bonded diamond wheel.

Stock Cutting and Tool Salvage

Cutting stock for making tools and dies, cutting broken tools for repointing, cutting chip breakers—if fast cutting action and long wheel life are most important he'll specify a resinoid wheel. But if a soft, free grinding action and minimum discoloration are essential it will probably be shellac bond.

Die Finishing

For the countless finishing jobs on dies, molds and tools he has nearly 200 standard sizes and shapes in the Norton line to select from—fast cutting 38 Alundum wheels and points with spindles of stainless steel.

Take advantage of this Norton Service—let it work for you these busy days.

NORTON COMPANY

WORCESTER, MASS.

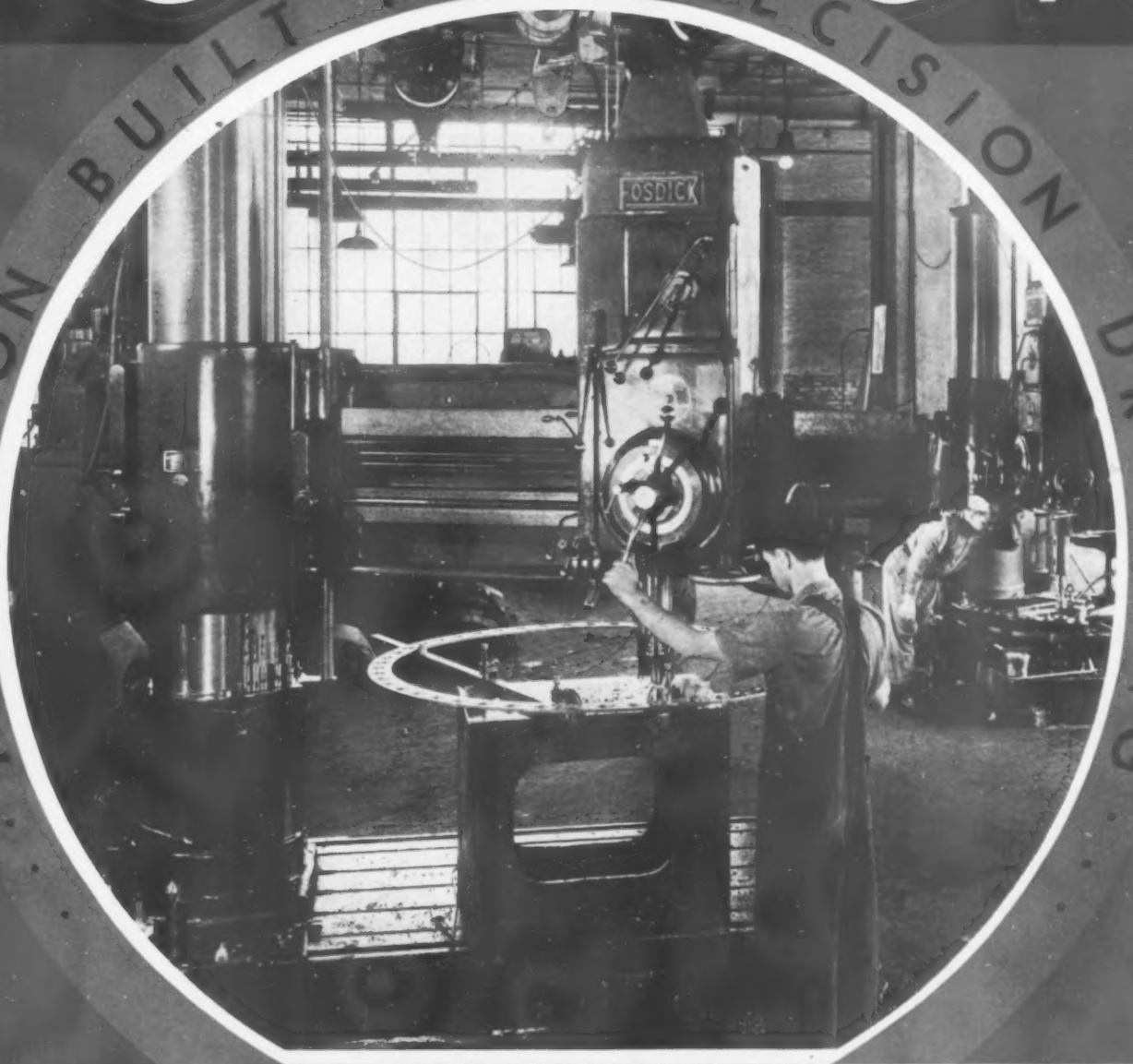
New York Chicago Detroit
Philadelphia Pittsburgh Hartford
Cleveland Hamilton, Ont.

NORTON ABRASIVES

W-800A

FOSDICK

PRECISION BUILT FOR PRECISION DRILLING



ECONOMAX *Hydraulic* RADIALS

Prove Versatility at Crown Cork & Seal Co.

● Drilling several holes at one setting in the large rings illustrated is a comparatively easy job for the two Fosdick Radials shown.

The convenience and simplicity of controls appeals to the operator and makes his work easier . . . your production greater . . . and costs lower.

A wide range of speeds are instantly available . . . adjustable spring counterbalance provides proper spindle balance . . . and an automatic safety feed stop are features that provide range for wide variety of work and freedom from work spoilage.

For versatility, speed and accuracy you can't go wrong with a Fosdick Economax Radial.

Ask for Economax Hydraulic Radial Bulletin R. A. for complete information

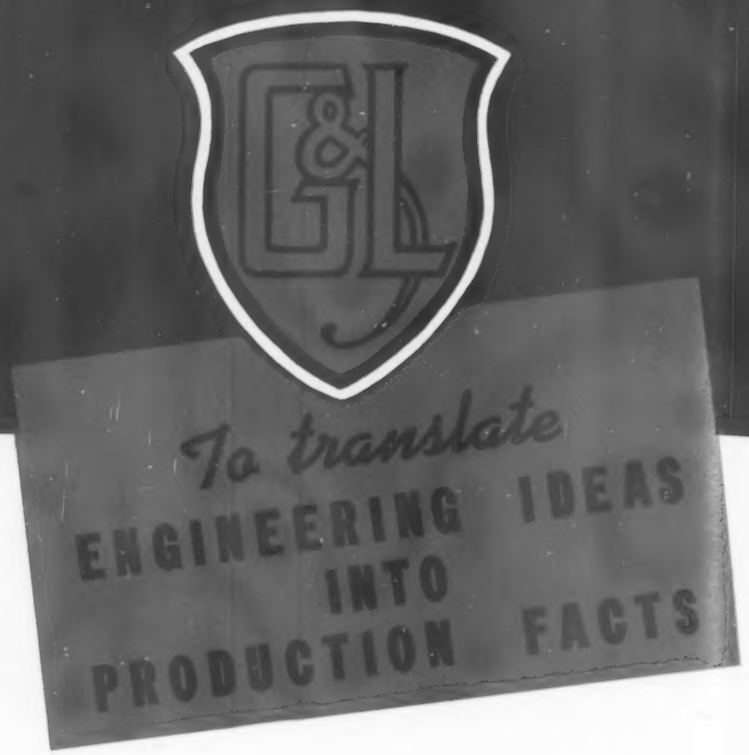
FOSDICK MACHINE TOOL COMPANY

CINCINNATI, OHIO

MANY TOOL ENGINEERS

Depend on

PRECISION FLEXIBILITY *and* VERSATILITY



Double Barreled Advantage

A G&L CAN DO WORK ON A LOT OF PARTS AND CAN DO IT ACCURATELY

Tool engineers are being called upon today for the quick solution of many problems new to their particular industry because of national defense work.

Whether the solution to the problem is one requiring new jigs and fixtures—simple or complicated—close limits—small or large lot production of parts heretofore unusual—the G&L horizontal boring, drilling and milling machine is proving most valuable.

If you are faced with the need for better quality and results, for greater speed, for increasing savings, for ways and means to aid labor, find out how a G&L will answer the need. There is a type and size best suited to your range of work.

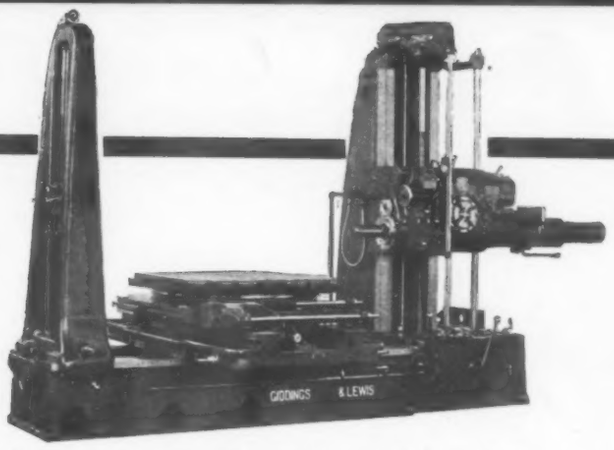
A G&L gives you the right speeds, feeds, and power to do the greatest variety of jobs. A G&L gives you flexibility and accuracy to save time and trouble. A G&L gives you a fully modern method.

A G&L makes it possible to handle all work on one setting on most jobs—it is the kind of versatility you should have.

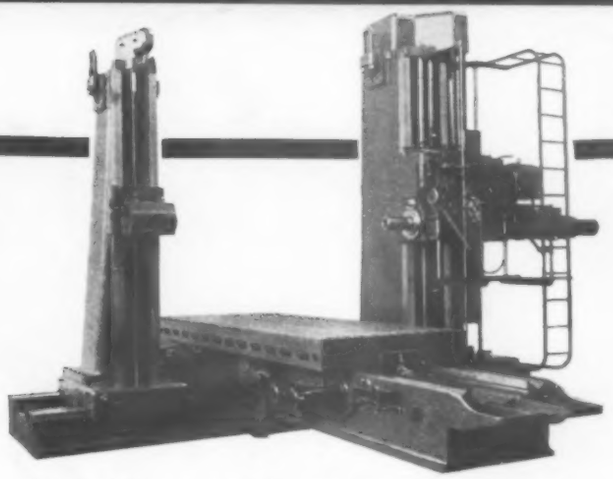
When you order a G&L you get a machine designed, not only to give you the most in speed and range of work, but because of its versatility and flexibility, one that will be of greatest value to you on the date it is placed in your service. We are adding an addition to our plant, so that you can have all the benefits of the G&L method at the earliest possible moment. You play safe when ordering a G&L Many-Purpose Machine.

GIDDINGS & LEWIS
MACHINE TOOL CO.
Fond Du Lac, Wis.
HORIZONTAL
BORING - DRILLING - MILLING MACHINES

THE MORE G & L USERS ------

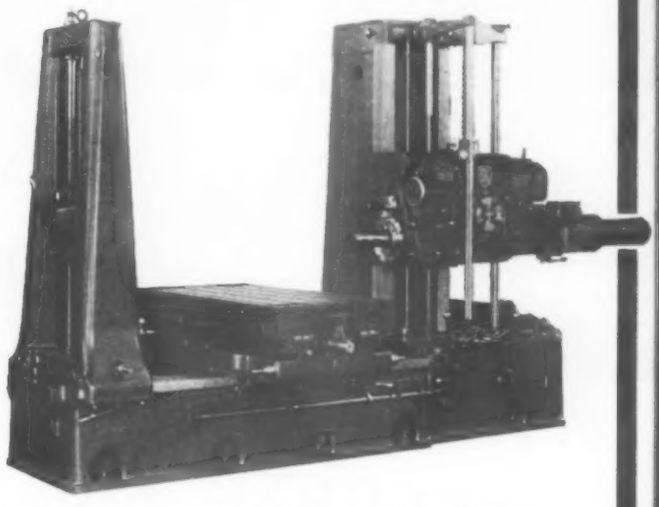


★ 340-RT: (4" main spindle), G&L Horizontal Boring, Drilling and Milling Machine with built-in 48" diameter power revolving table

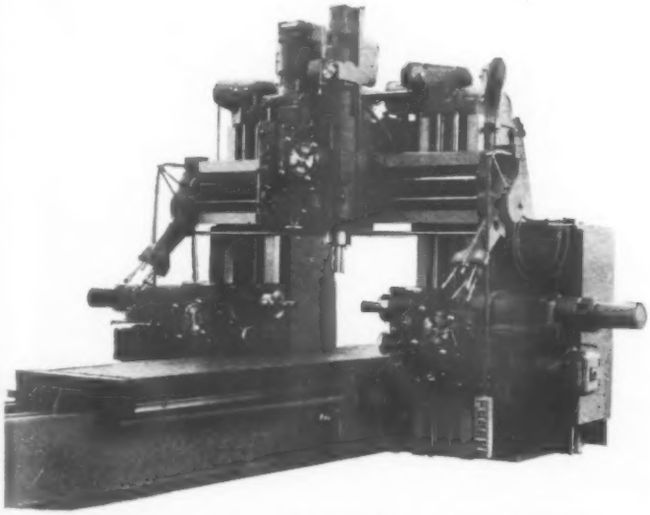


★ 360-P: (6" main spindle) Planer Type, G&L Horizontal Boring, Drilling and Milling Machine

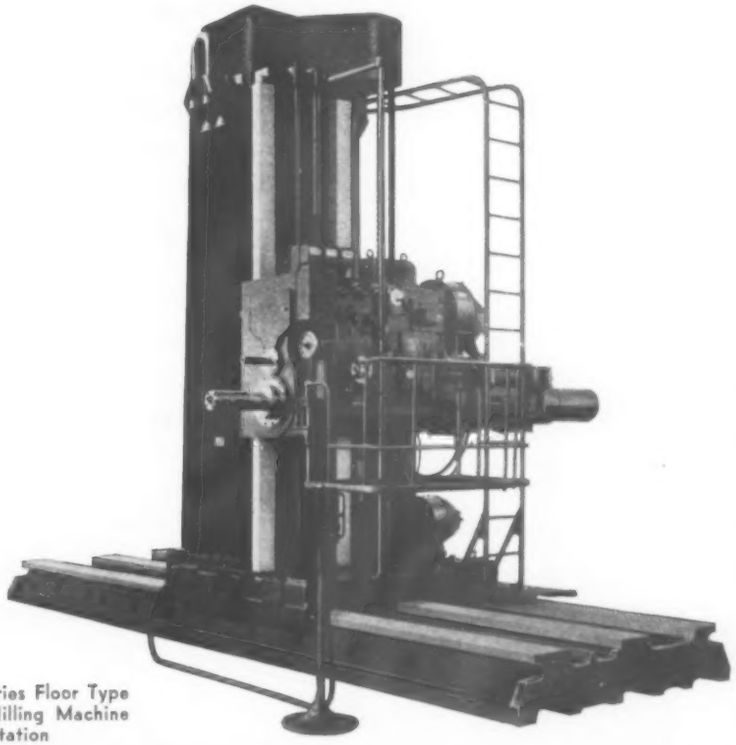
Send us your prints of castings or tell us the kind of work you have and we shall be glad to outline the possibilities of one of our machines on your type of work. Descriptive bulletins, covering every type of G&L Horizontal Boring, Drilling and Milling Machine, engineering recommendations, and G&L service are offered to manufacturing executives. If you wish, G&L representatives will gladly call and give you all of the facts on the G&L Method.



★ 340-T: (4" main spindle) Table Type G&L Horizontal Boring, Drilling and Milling Machine



★ 340-PQ3H: 3 head-planer type G&L Horizontal Boring, Drilling and Milling Machine



★ 560-F: (6" main spindle) new 50 series Floor Type G&L Horizontal Boring, Drilling and Milling Machine with portable remote control station

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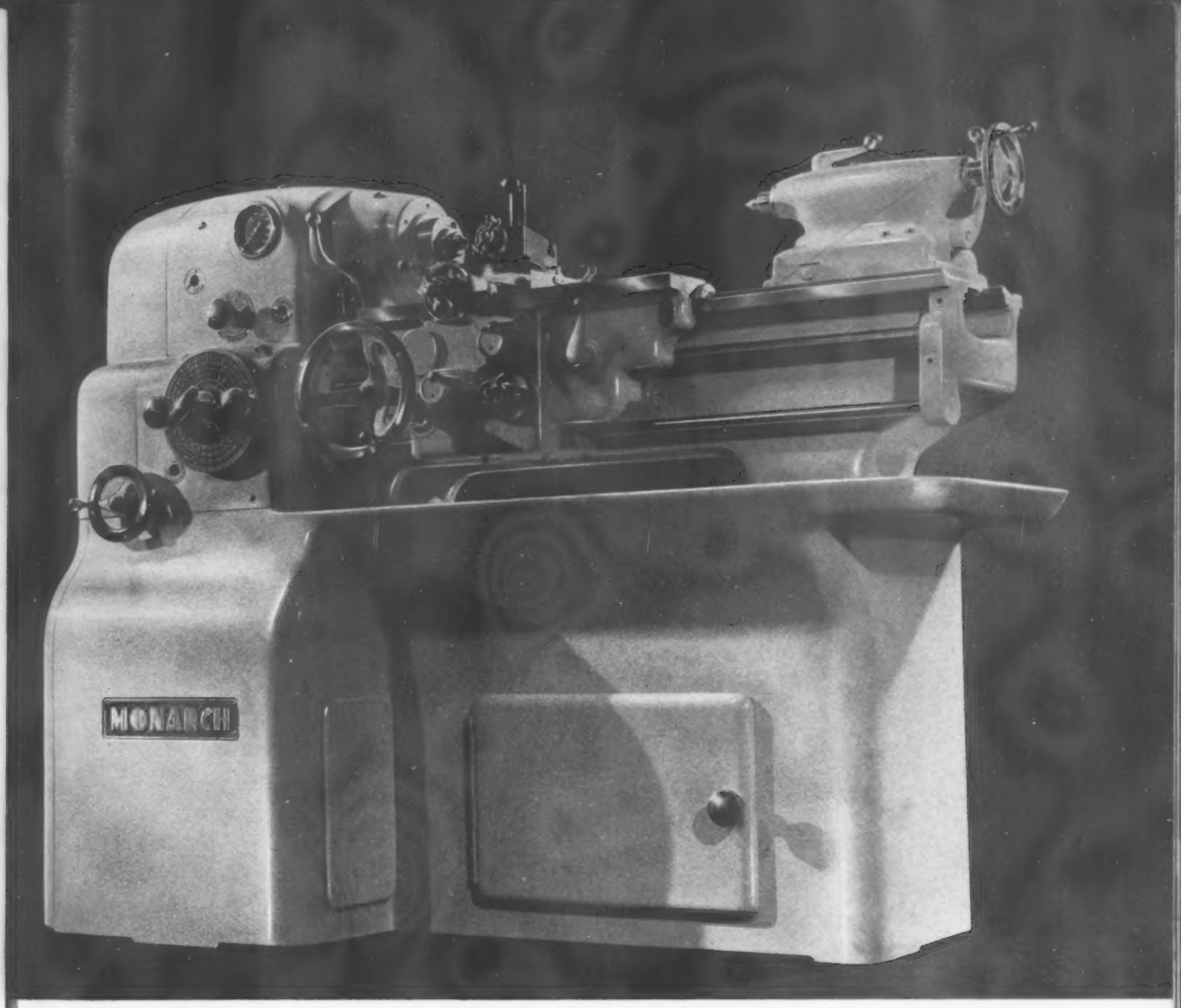

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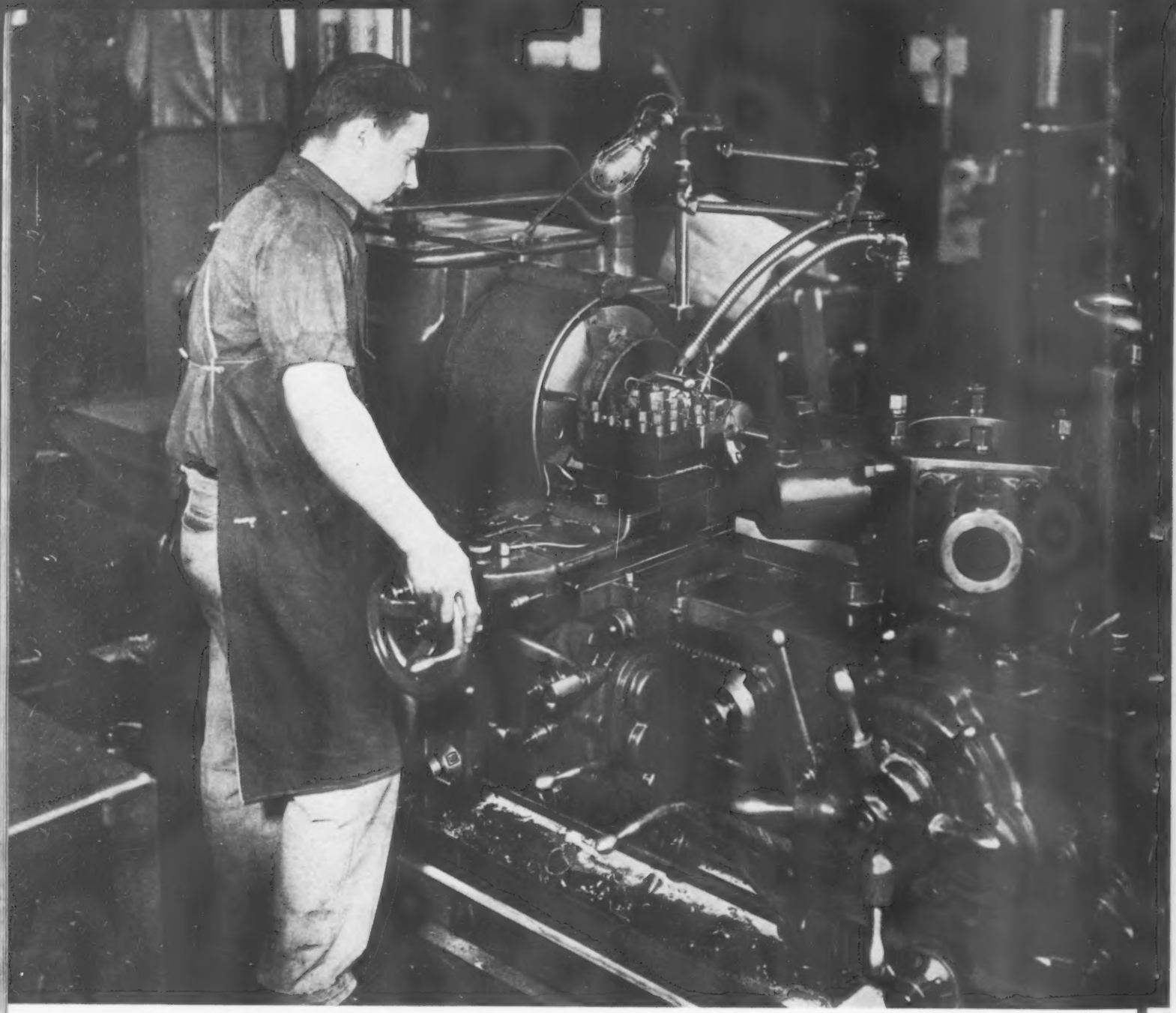

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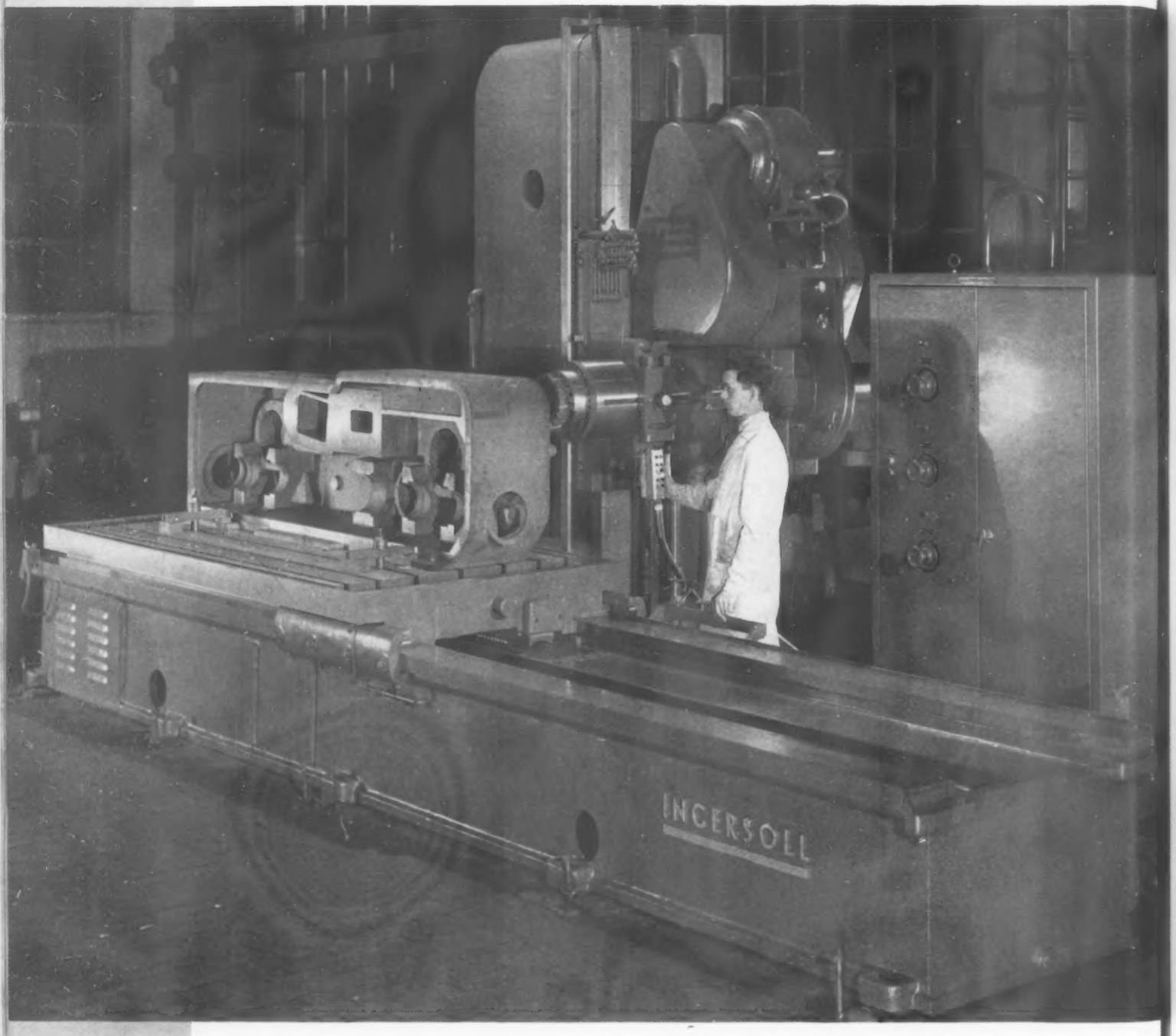

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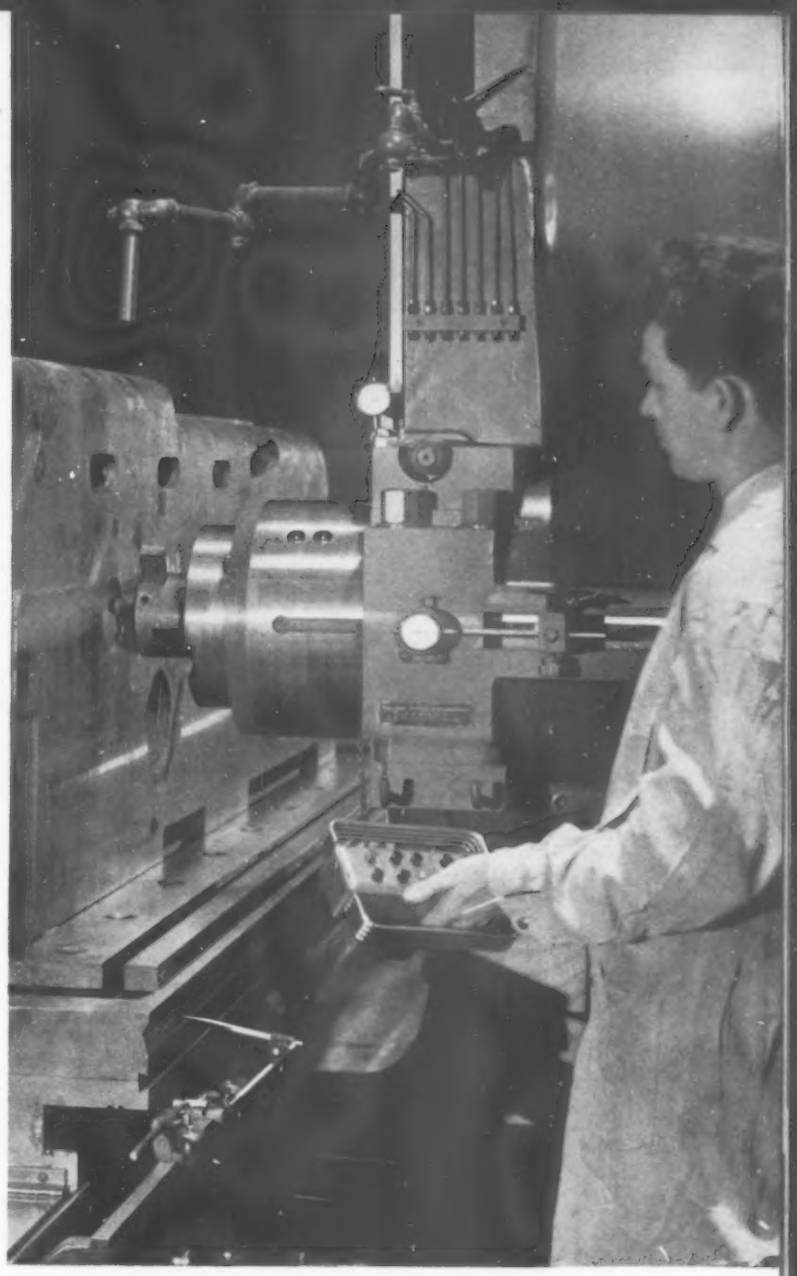
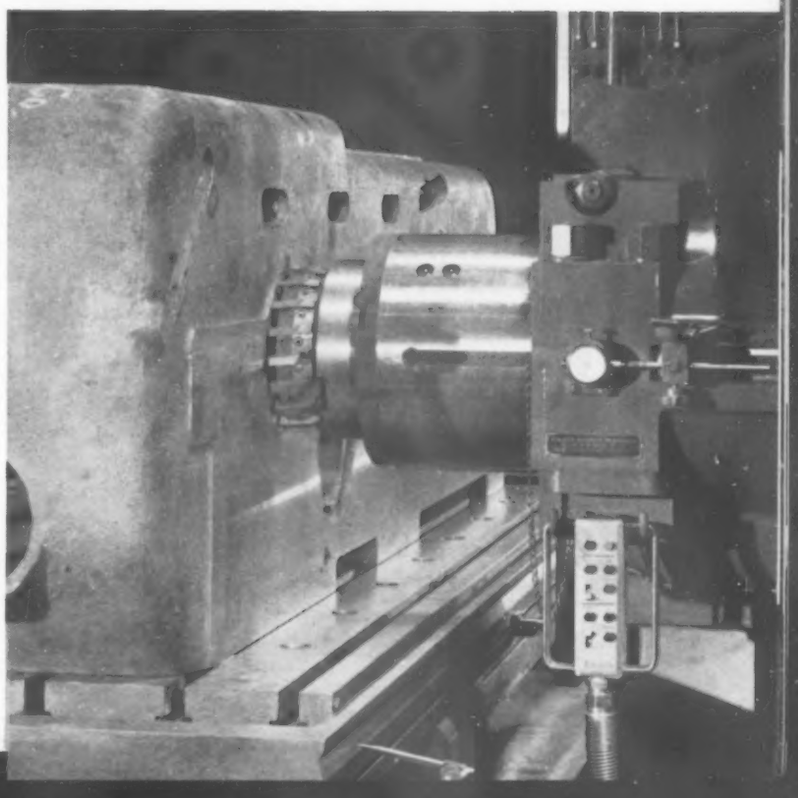
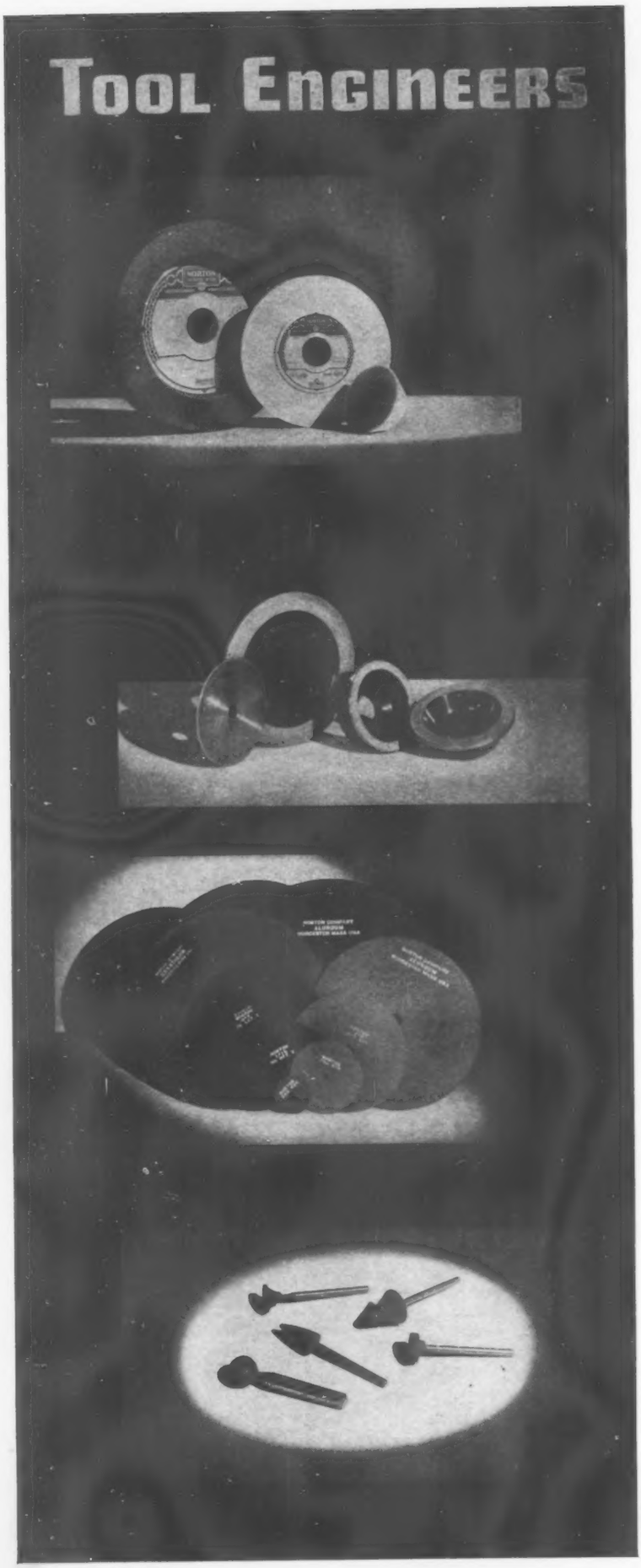




THE INGERSOLL MILLING MACHINE CO.

ROCKFORD, ILLINOIS



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Die Finishing

For the countless finishing jobs on dies, molds and tools he has nearly 200 standard sizes and shapes in the Norton line to select from—fast cutting 38 Alundum wheels and points with spindles of stainless steel.

Take advantage of this Norton Service—let it work for you these busy days.

NORTON COMPANY

WORCESTER, MASS.

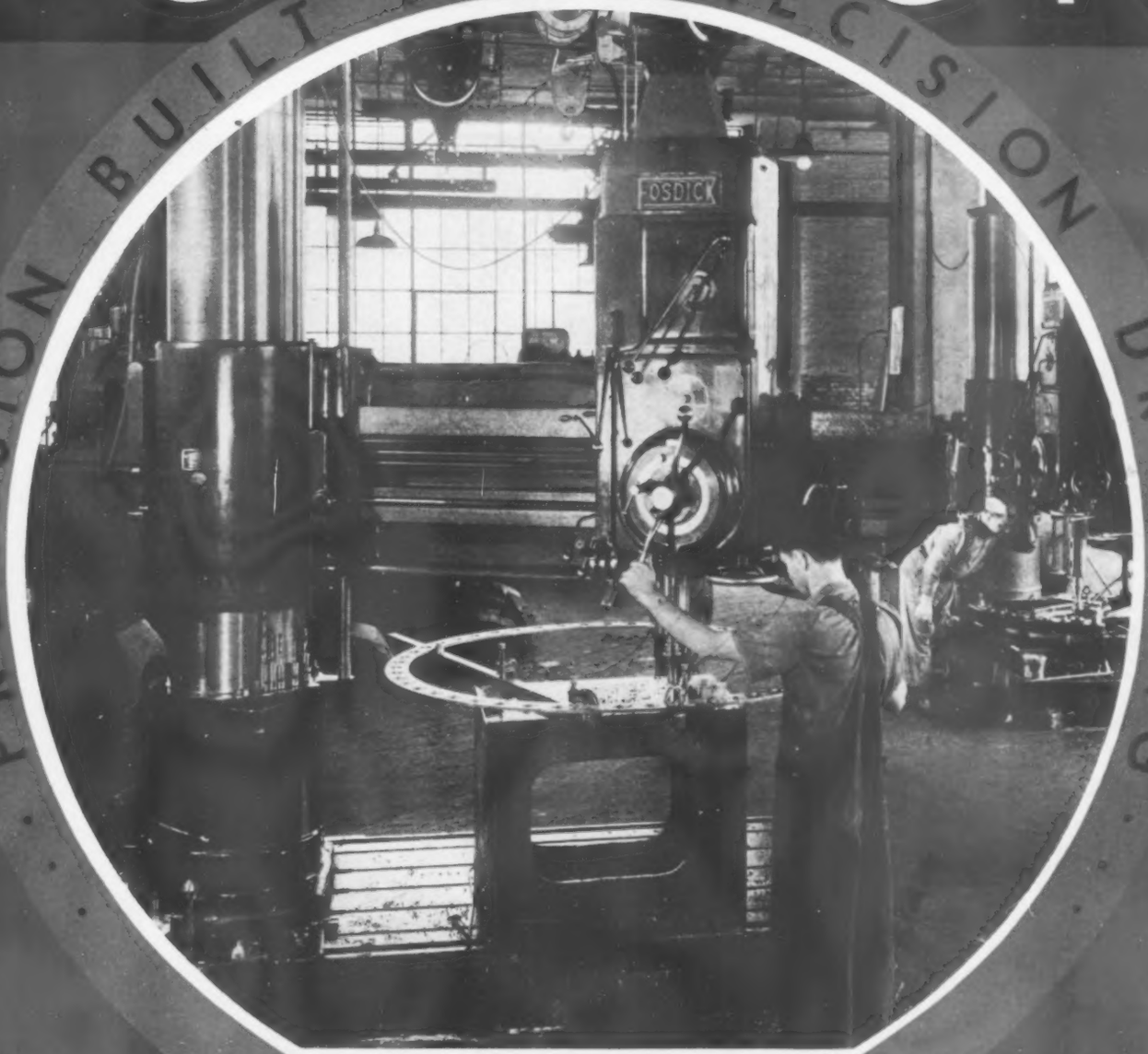
New York Chicago Detroit
Philadelphia Pittsburgh Hartford
Cleveland Hamilton, Ont.

NORTON ABRASIVES

W-800A

FOSDICK

PRECISION BUILT FOR PRECISION DRILLING



ECONOMAX *Hydraulic* RADIALS

Prove Versatility at Crown Cork & Seal Co.

● Drilling several holes at one setting in the large rings illustrated is a comparatively easy job for the two Fosdick Radials shown.

The convenience and simplicity of controls appeals to the operator and makes his work easier . . . your production greater . . . and costs lower.

A wide range of speeds are instantly available . . . adjustable spring counterbalance provides proper spindle balance . . . and an automatic safety feed stop are features that provide range for wide variety of work and freedom from work spoilage.

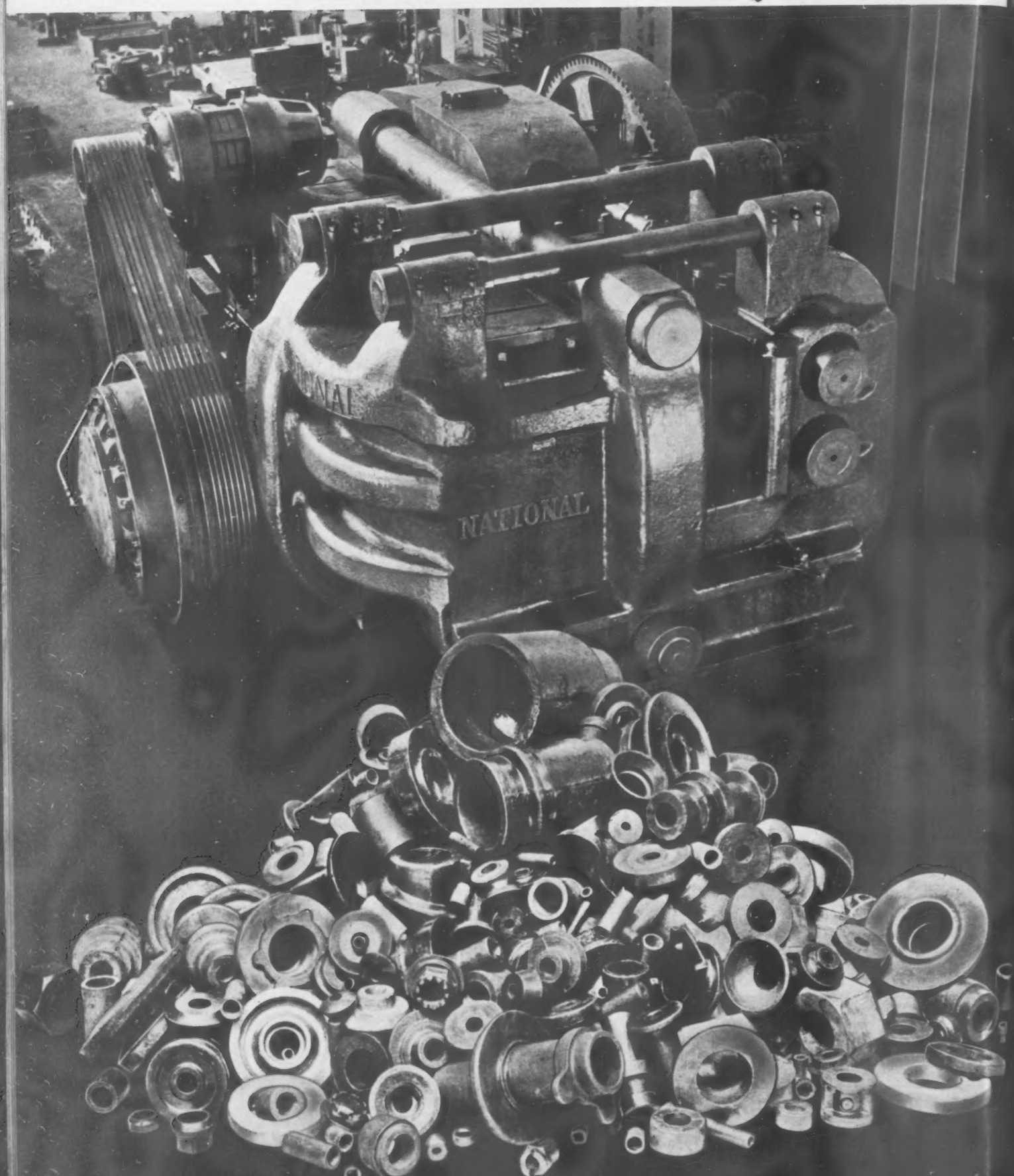
For versatility, speed and accuracy you can't go wrong with a Fosdick Economax Radial.

Ask for Economax Hydraulic Radial Bulletin R. A. for complete information

FOSDICK MACHINE TOOL COMPANY

CINCINNATI, OHIO

Peace *and*



Preparedness

NATIONAL Engineers have designed and perfected many shell and bomb dies; which, combined with the speed, accuracy and versatility of National Forging Machines make Nationals the logical choice for such work.

And, eventually, these same machines will be needed for an endless variety of Peace Time commercial forgings.

Why not install Nationals and be prepared both ways?

The National Machinery Co.

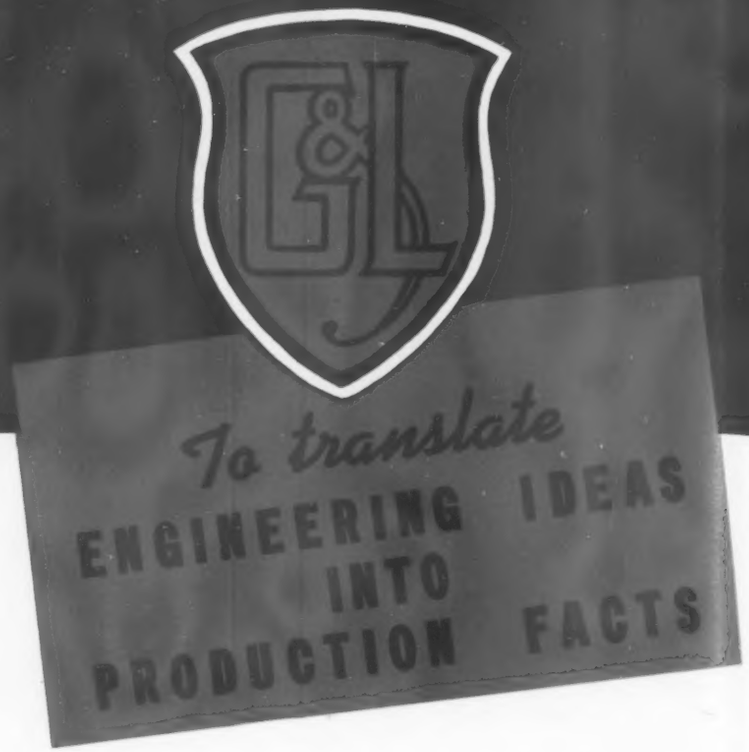
Tiffin, Ohio, U. S. A.

New York Detroit Chicago

MANY TOOL ENGINEERS

Depend on

PRECISION FLEXIBILITY *and* VERSATILITY



Double Barreled Advantage

A G&L CAN DO WORK ON A LOT OF PARTS AND CAN DO IT ACCURATELY

Tool engineers are being called upon today for the quick solution of many problems new to their particular industry because of national defense work.

Whether the solution to the problem is one requiring new jigs and fixtures—simple or complicated—close limits—small or large lot production of parts heretofore unusual—the G&L horizontal boring, drilling and milling machine is proving most valuable.

If you are faced with the need for better quality and results, for greater speed, for increasing savings, for ways and means to aid labor, find out how a G&L will answer the need. There is a type and size best suited to your range of work.

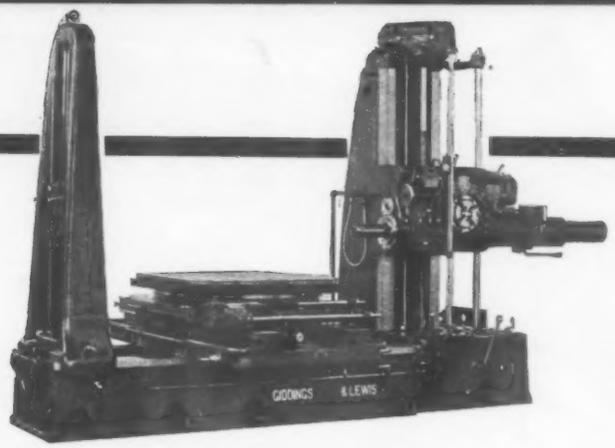
A G&L gives you the right speeds, feeds, and power to do the greatest variety of jobs. A G&L gives you flexibility and accuracy to save time and trouble. A G&L gives you a fully modern method.

A G&L makes it possible to handle all work on one setting on most jobs—it is the kind of versatility you should have.

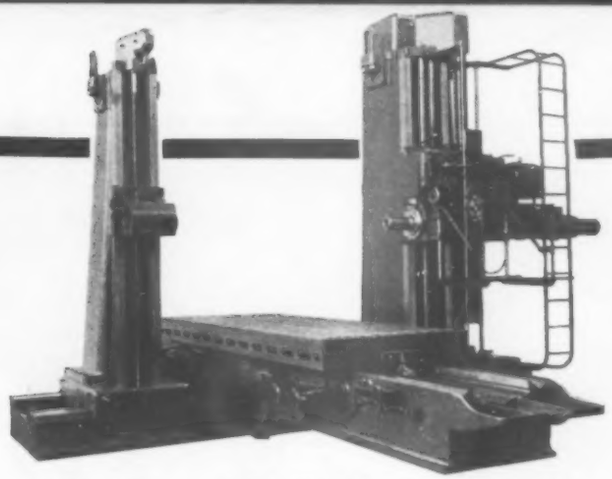
When you order a G&L you get a machine designed, not only to give you the most in speed and range of work, but because of its versatility and flexibility, one that will be of greatest value to you on the date it is placed in your service. We are adding an addition to our plant, so that you can have all the benefits of the G&L method at the earliest possible moment. You play safe when ordering a G&L Many-Purpose Machine.

GIDDINGS & LEWIS
MACHINE TOOL CO.
Fond Du Lac, Wis.
HORIZONTAL
BORING - DRILLING - MILLING MACHINES

THE MORE G & L USERS ------

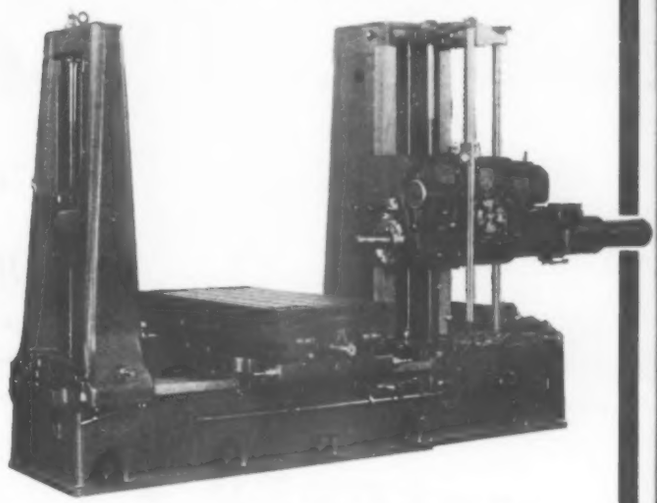


★ 340-RT: (4" main spindle), G&L Horizontal Boring, Drilling and Milling Machine with built-in 48" diameter power revolving table

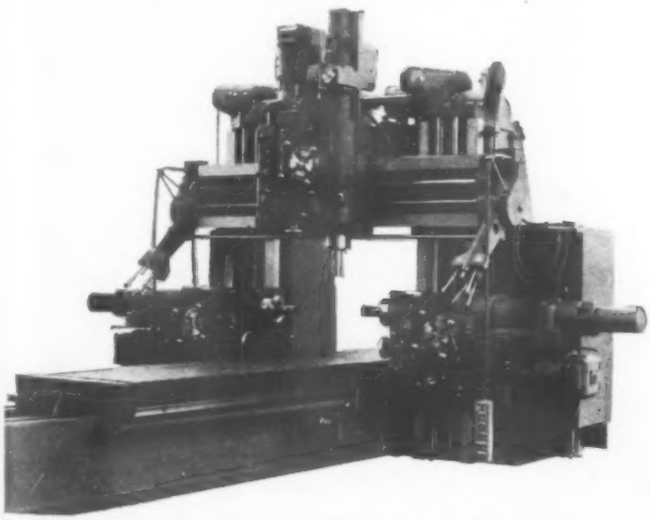


★ 360-P: (6" main spindle) Planer Type, G&L Horizontal Boring, Drilling and Milling Machine

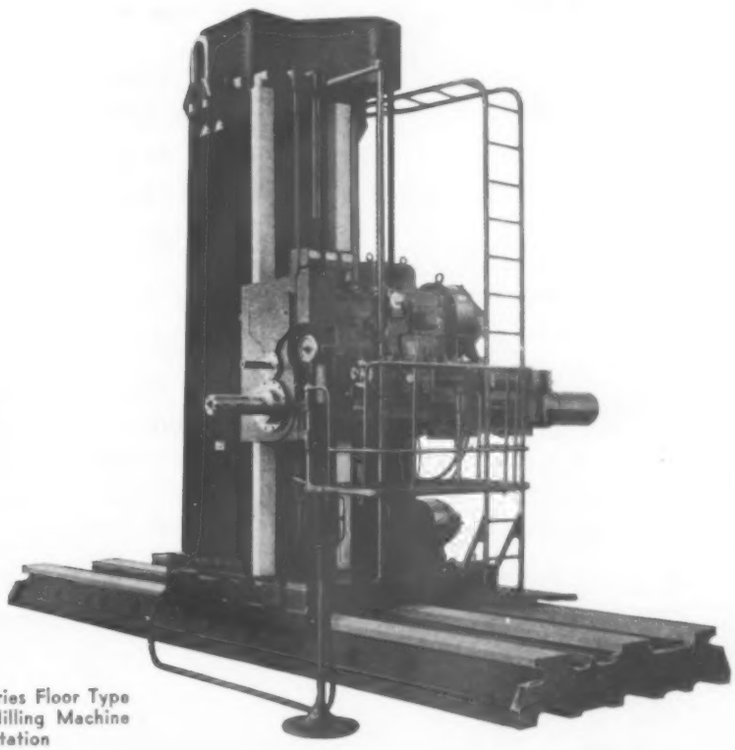
Send us your prints of castings or tell us the kind of work you have and we shall be glad to outline the possibilities of one of our machines on your type of work. Descriptive bulletins, covering every type of G&L Horizontal Boring, Drilling and Milling Machine, engineering recommendations, and G&L service are offered to manufacturing executives. If you wish, G&L representatives will gladly call and give you all of the facts on the G&L Method.



★ 340-T: (4" main spindle) Table Type G&L Horizontal Boring, Drilling and Milling Machine



★ 340-PQ3H: 3 head-planer type G&L Horizontal Boring, Drilling and Milling Machine



★ 560-F: (6" main spindle) new 50 series Floor Type G&L Horizontal Boring, Drilling and Milling Machine with portable remote control station

THE MORE G & L BOOSTERS

—"INSURED" FOR LONG LIFE BY DYNETRIC BALANCING MACHINES

● How long these armatures deliver efficient service will depend largely upon their proper static and dynamic balance. For, in any high-speed rotating part—from diesel locomotive generators to the tiny rotor in your electric razor—unbalance means vibration, excessive wear, and shorter life. The best "insurance" against it is proper balance.

This fact has long been known to manufacturers. But until recently, accurate balancing was a costly, time-consuming operation. Now, the new Gisholt Balancing Machines enable you quickly to locate and measure unbalance in terms of practical "correction units." It's all done in a few seconds—detecting unbalance vibrations as small as .000025".

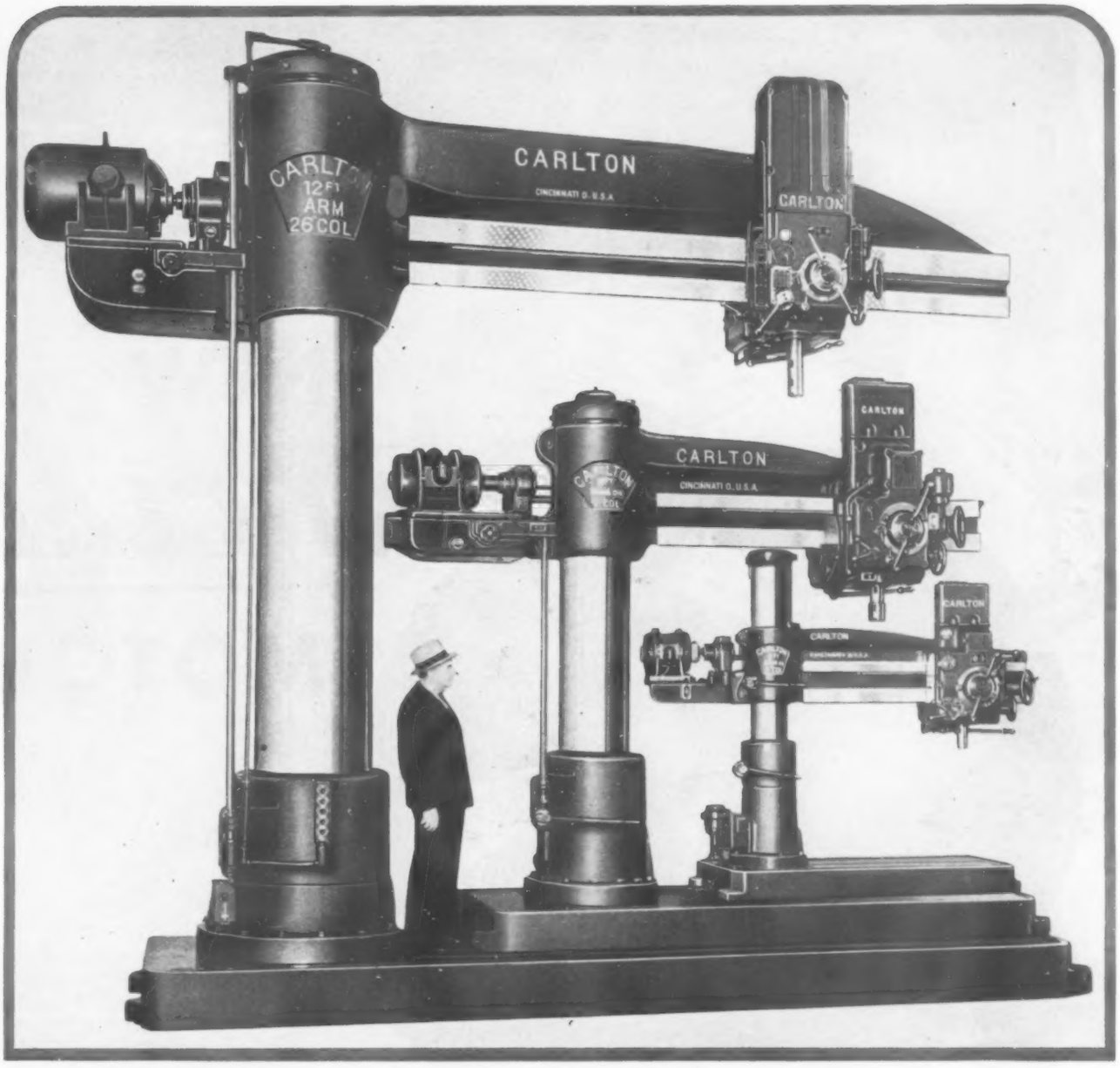
GISHOLT MACHINE COMPANY
1201 East Washington Avenue • Madison, Wisconsin

How Gisholt Balancing Machines provide quick, accurate balancing for many different sizes and types of parts is explained in an interesting, new 30-page bulletin. Your copy will be sent on request.

GISHOLT

Look Ahead . . . Keep Ahead . . . With Gisholt Improvements

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES



CARLTON RADIAL DRILLS

SPECIAL FEATURES

1. Low Hung Drive to Spindle
2. All Power Driven Parts Run in Oil
3. Quiet Running at all Speeds
4. Concentrated, Convenient Controls
5. Constructed on Unit Principle

Manufactured in sizes Nine inch to twenty-six inch columns and three foot to twelve foot arms.

The CARLTON MACHINE TOOL CO.
CINCINNATI OHIO, U.S.A.

THE MOTOR YOU ASKED FOR

NEW TRI/CLAD MOTOR

No other standard motor, we believe, has ever met the general-purpose requirements of industry with so well-balanced a combination of performance characteristics, convenience features, and provisions for protection. Integral-hp sizes up to 20 hp (at 3600 rpm), open or splashproof, are now available. Capacitor-motors up to 5 hp (at 3600 rpm) can also be furnished.

BUILT FOR PROTECTION FIRST...TO LAST

IS STRONG ON PROTECTION

Extra Protection
AGAINST PHYSICAL DAMAGE

A truly modern motor, you told us, must be able to withstand accidental blows, flying chips, dripping liquids, and occasional bumps in moving or mounting. That's how we built the Tri-Clad motor!

We made the frame and end shields of cast iron; used channel and rib sections to give ample strength where needed, without increasing the weight; cast the feet integrally with the frame to make them sturdy and rigid. We completely enclosed the upper portion and carefully baffled all ventilating openings to protect vital motor parts. We provided the bearings with cast-iron housings and made them dust tight. And the finishing touch—we give the motor a tough coat of paint that protects the metal parts against rust and corrosion.

The Tri-Clad motor is fully protected against the accidental ill-treatment some motors encounter all the time, and which *all* motors encounter some of the time. As a safeguard against production interruptions, as a prime factor in lowering costs, as an extra increment of value on machines you build, you'll find that this new motor means extra profit protection, too.

Be sure your next induction motors are Tri-Clad. General Electric, Schenectady, N. Y.

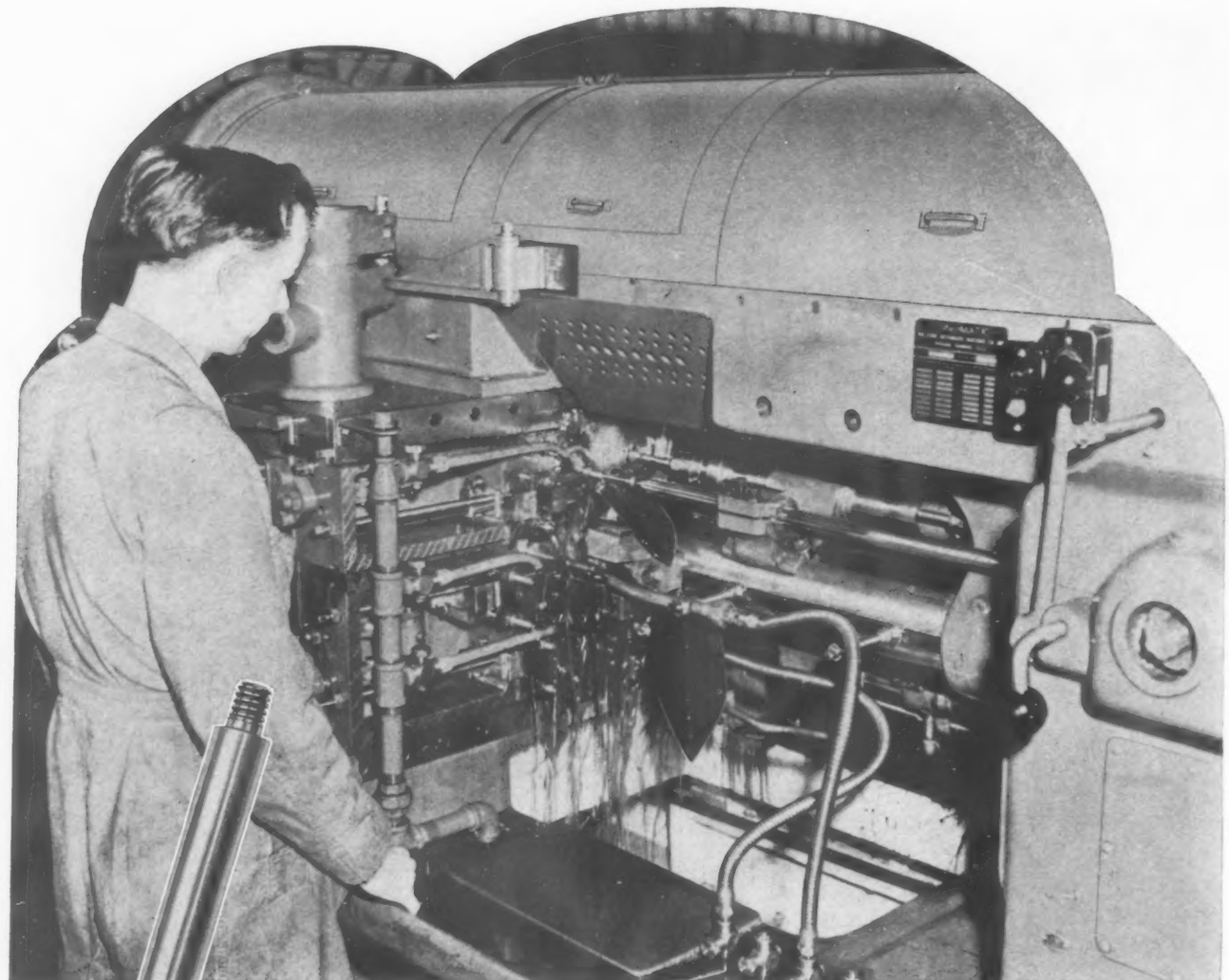
Extra Protection
AGAINST ELECTRICAL BREAKDOWN

New stator windings of Formex wire give extra protection internally against moisture, oil, abrasion, and heat aging. New synthetic impregnating and protecting varnishes make a rigid unit with a hard finish.

Extra Protection
AGAINST OPERATING WEAR AND TEAR

Sleeve bearings of new design have longer life and greater load capacity. The one-piece, cast-aluminum rotor winding, with fans cast integrally, is practically indestructible.

GENERAL ELECTRIC



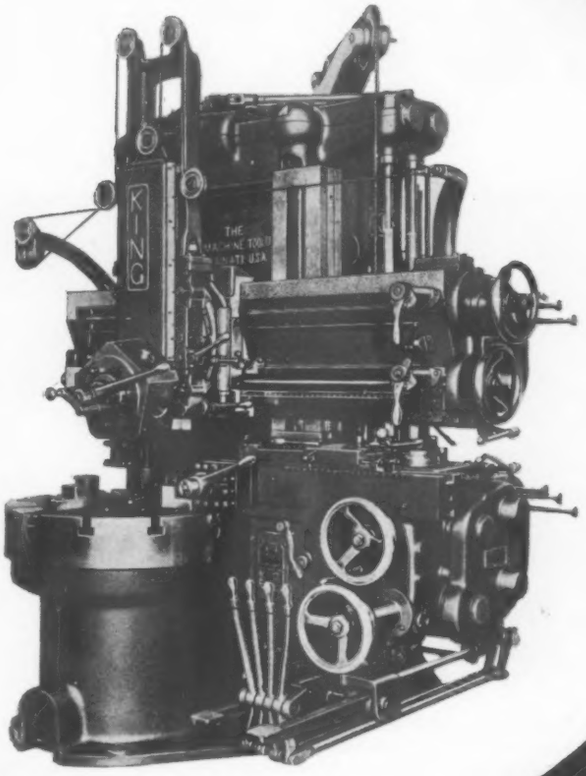
COMBINED CUTS AND CONOMATICS

AN IDEAL COMBINATION

A 1¼" Six-Spindle Conomatic produces the 4¼" brass valve stem (at left) in 9 seconds. The 11 operations performed on this part include 4 forming cuts, 4 cuts with roller turners, 2 threading operations, and cutting off — all to close tolerances. By combining machining operations on a Conomatic, you can expect a reduction in the cost of your product — improving it without added cost — and an increase in profits. Send prints of your machine parts to Cone for a complete cost analysis. There is no obligation.

CONE AUTOMATIC MACHINE CO., INC.
WINDSOR, VERMONT, U. S. A.

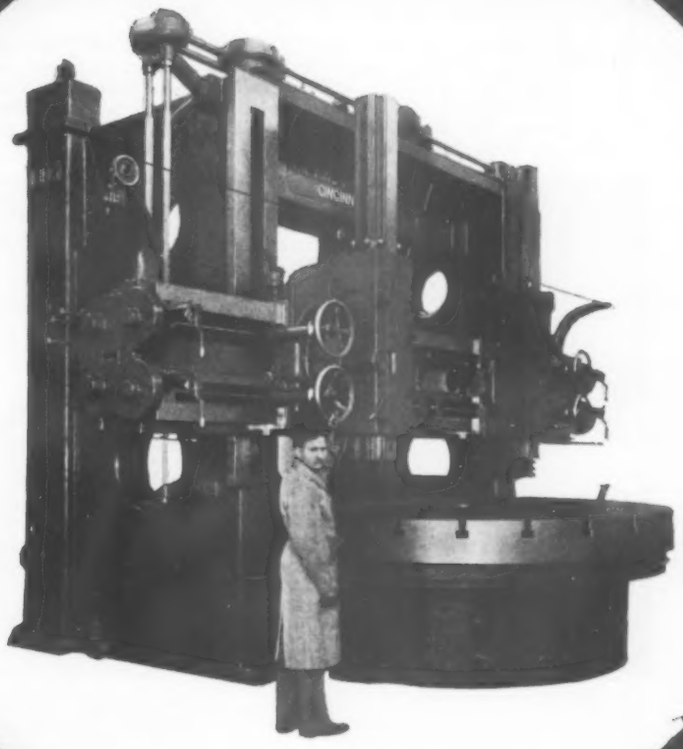
ESSENTIAL to 1941
TURNING and BORING NEEDS



← KING

NEW 30 IN. VERTICAL CHUCKING MACHINE

Table Diameter 30"
Maximum Swing 34"
Maximum Height under rail 24"
Net Weight 20,000 lbs.



KING →

10 FT. VERTICAL BORING & TURNING MACHINE

Table Diameter 120"
Maximum Swing 126"
Maximum Height under rail 80"
Net Weight 140,000 lbs.

VALUABLE INFORMATION AVAILABLE FOR THE ASKING

The KING MACHINE TOOL Company

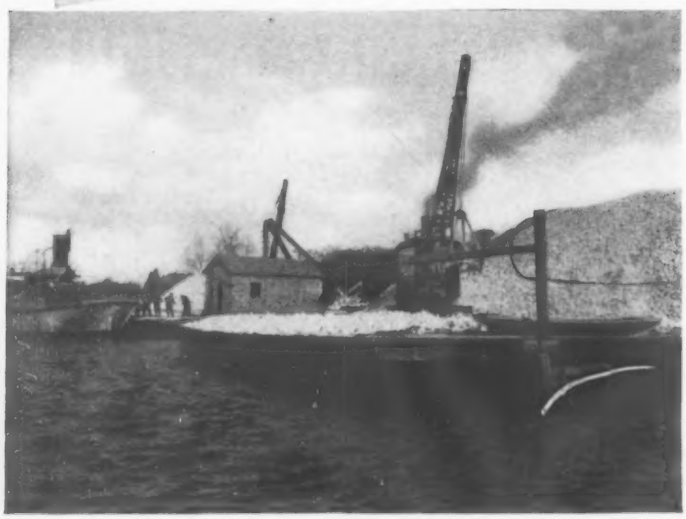
Builders of Vertical Boring and Turning Machines Exclusively

CINCINNATI • • • OHIO

READ

HOW AMERICAN NEPHELINE CORPORATION DID IT WITH ALLIS-CHALMERS TEXROPE V-BELT DRIVE EQUIPMENT!

Solved—



1 DISCOVERED! A NEW ORE TO REPLACE FELDSPAR AS A flux in glass-making and other ceramic industries! Found commercially only in Ontario, the new material — Lakefield Nepheline Syenite ($Na_2O\ Al_2O_3\ SiO_2$) — contains as much as 24 per cent of the flux-quality, alumina. To prepare it for market, in the modern plant of American Nepheline Corporation in nearby Rochester, N. Y. . . .

2 THE IRON CONTENT OF LAKEFIELD NEPHELINE SYENITE must be reduced from one percent to a negligible amount. Called in by American Nepheline to solve this problem, the Dings Magnetic Separator Co., Milwaukee, faces a problem of its own — powerful iron-removing magnetic action attracts chain drives, draws them to the magnet side of their sprockets, wears them out in short order!

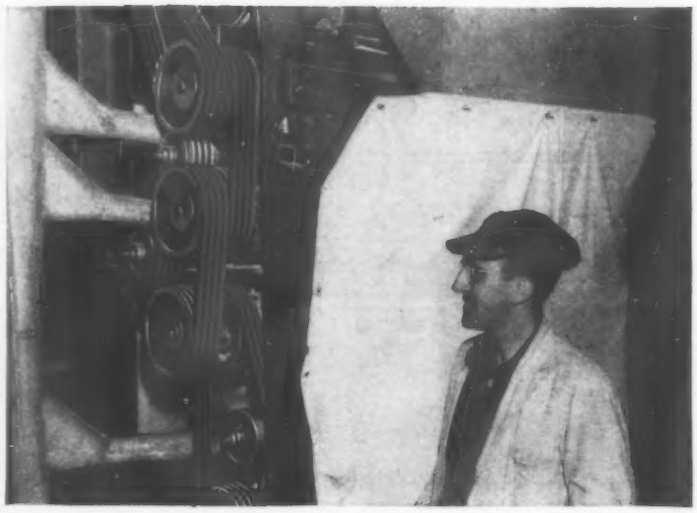
3 RECALLING OTHER SUCCESSFUL APPLICATIONS OF TEXrope Drives, Dings' officials invite in Allis-Chalmers engineers. Soon these trained engineers offer Dings' Bill Soli their solution — Texrope Drives engineered for their particular job . . . completely compact and positive, and — in no way vulnerable to the effects of Dings' magnetic action! Dings officials then observe how . . .

4 TEST RUNS USING TEXROPE DRIVES IN THE LABORATORY uphold their hope for greatly increased drive efficiencies. Without delay, four Dings units are equipped, each with four precision-engineered Texrope Drives from the huge stock at the Allis-Chalmers plant (as carried in warehouses throughout the country) . . . shipped speedily to help prepare Nepheline Syenite. Installed . . .

TEXROPE DRIVES CUT

THE RIDDLE OF FORMULA

$Na_2O\ Al_2O_3\ SiO_2$



5 NOW IN AMERICAN NEPHELINE'S PLANT, THE FOUR Dings units operate more efficiently than ever before . . . while American Nepheline engineers observe how smooth sides of Texrope V-belts repel ore dust, resist magnet induced wear. With other Texrope-driven units, Dings Separators are now a part of American Nepheline's production, operate without costly breakdowns! —

6 GRATEFUL FOR SOLUTION OF THEIR PROBLEM, American Nepheline commends Dings Magnetic Separator Co. In turn, Dings' Bill Soli acknowledges Texrope engineering cooperation . . . praises Allis-Chalmers Texrope products . . . money-saving products that successfully solve hundreds of power transmission problems in thousands of industrial plants throughout the world!

Save Money With Allis-Chalmers Texrope V-belt Drive Equipment — the Modern Power Transmission That Gives You Silent . . . Shock-Proof . . . Safe . . . Flexible . . . Efficient Operation . . . PLUS a Cooperative Engineering Service That's Truly Cooperative!

WHEN YOU specify Allis-Chalmers Texrope Drives on your machines, you get *Double Value!*

For Texrope gives you not only an unequalled record for long life . . . low maintenance . . . and year 'round dependability — but a unique cooperative engineering service as well.

Allis-Chalmers has the longest and broadest experience in the V-belt drive field. Over a decade ago, Allis-Chalmers originated and developed multiple V-belt drives . . . has led in their advancement ever since.

That means, as transmission engineers to industry, we can work with you . . . can direct this broad experience at helping solve *your* transmission problems!

And don't forget — this Double Value is yours at no extra cost. Get the facts about Texrope . . . today. Call your nearest Texrope dealer, or write Allis-Chalmers, Milwaukee, Wisconsin.

A-1361

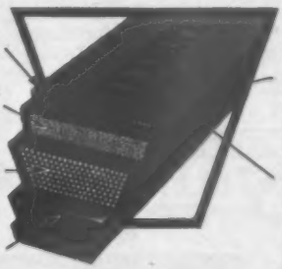
WHEN ORDERING REPLACEMENTS, REMEMBER . . . ONLY TEXROPE V-BELTS GIVE YOU ALL THESE OUTSTANDING FEATURES!

Extra-tough, two-ply cover gives EXTRA-PROTECTION against abrasive wear . . . eliminates need for belt dressing of any kind.

Special bias cut fabric adds transverse strength . . . provides DOUBLE SAFETY against belt breakage.

Rugged load-carrying cords, impregnated in a special, cool-flexing gum insure unvarying length . . . GREATER strength . . . MORE pulling power.

Amazing cool-running rubber compound absorbs shock . . . assures silent, vibrationless operation . . . ACTUALLY INCREASES BELT LIFE 100 TO 200% OVER BELTS OF ONLY A FEW YEARS AGO!



Belts by Goodrich

Texropes are TRUE V-BELTS . . . with famous STRAIGHT-EDGE WEDGE design that gives efficiencies up to 98.9% . . . prevents slipping, jerking. Because they are matched in a special precision measuring machine, sets of Texropes are uniform to a fraction of an inch in length — your guarantee of equalized pulling . . . even wear . . . longer life.

LOOK for the name TEXROPE . . . stamped on every belt! It identifies the only GENUINE Texrope . . . backed by Allis-Chalmers, originators of the multiple V-belt drive. You can get genuine Texropes and Texrope Drives instantly from Allis-Chalmers warehouses and distributor stocks throughout the world.

TRANSMISSION COSTS

When *You Have to Contend with*

ABRASION, HEAT, AND CORROSION

Use Haynes Stellite Alloy Specialties

A unique combination of properties makes Haynes Stellite alloy the outstanding material for innumerable applications where high resistance to abrasion, heat, or corrosion is required. Look over the interesting characteristics of Haynes Stellite alloy listed below:

- Haynes Stellite alloy is inherently hard and abrasion-resistant — even at red heat.
- It is extremely resistant to atmospheric corrosion, and also resists the action of many common corrosive agents.
- It is practically non-magnetic.
- It takes an extremely high polish.
- It has a low coefficient of friction.

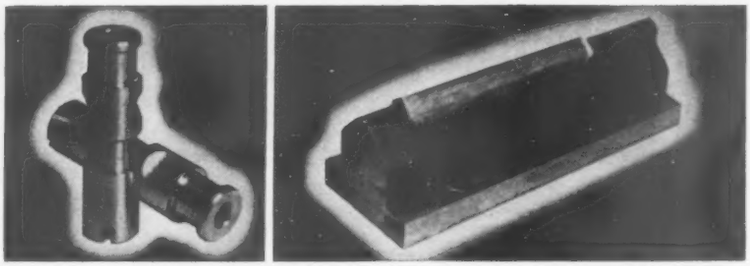
You can obtain Haynes Stellite alloy specialties cast and finished to your own specifications. Use this modern material to reduce down-time and decrease maintenance costs.

Let us help you investigate the advantages of using Haynes Stellite alloy specialties in your business. Write the nearest district office, without obligation.

HAYNES STELLITE COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
General Office and Works—Kokomo, Indiana
Foreign Sales Department—New York, N. Y.

District Offices
Chicago—Cleveland—Detroit—Houston—
Los Angeles—New York—San Francisco—Tulsa

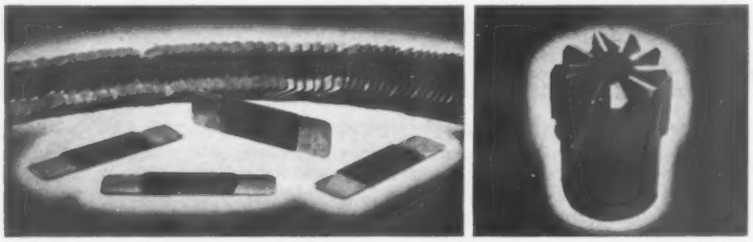
Information on Haynes Stellite Company products is also available through all apparatus shipping points of The Linde Air Products Company.



Automotive — These fuel pump plunger lever pins for diesel engines are cast of Haynes Stellite alloy and finished to accurate dimensions. They resist abrasion and corrosion.

Electrical—This solid die—used in the manufacture of electrical products—weighs 10 lb. By contrast, Haynes Stellite alloy phonograph needles are also cast and ground.

Petroleum—Pump rods like this are made by butt-welding steel or nickel alloy ends to the Haynes Stellite alloy center, where abrasive and corrosive action occurs. Such composite specialties are frequently used.



Rubber—These rubber cutter knives, made from rolled sheet of a malleable grade of Haynes Stellite alloy, retain a sharp cutting edge for a long period of service.

Machinery—Red hardness and high cutting quality characterize standard Haynes Stellite metal-cutting tools, and also special tools such as the spot facer shown above.

Valves—This cast and ground seat ring for an "anti-coking valve" is used in conjunction with a Haynes Stellite alloy valve stem, to withstand heat, abrasion, and corrosion.

Chemicals—These Haynes Stellite alloy battery mix knife parts, used in the manufacture of dry batteries, resist the severe abrasion and chemical corrosion encountered.

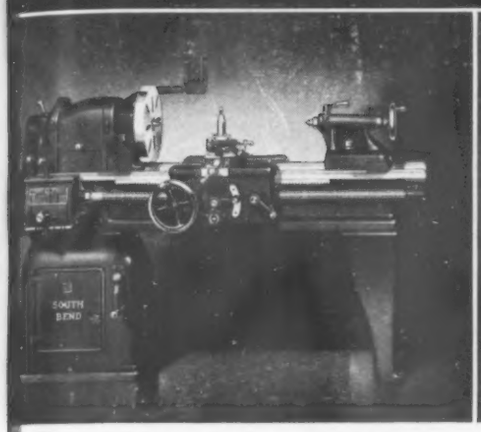
HAYNES STELLITE TRADE MARK

Red-hard, wear-resisting alloy of cobalt, chromium, and tungsten.

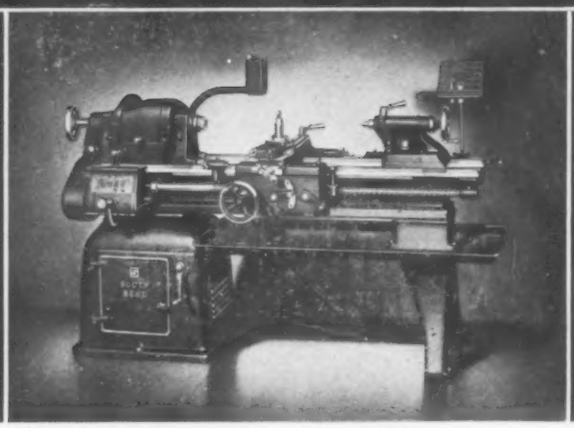
"Haynes Stellite" is a registered trade-mark of Haynes Stellite Company

Haynes Stellite Company products will be displayed at Area 362, Machine and Tool Progress Exhibition; Convention Hall, Detroit; March 25-29.

The RIGHT *Lathe For Every Shop Need*



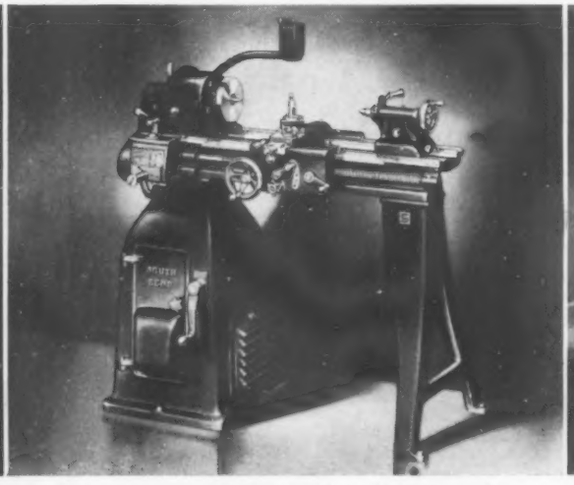
16″ swing South Bend Underneath Motor Drive Quick Change Gear Precision Lathe.



14½″ swing South Bend Tool Room Underneath Motor Drive Precision Lathe.

13″ swing South Bend Underneath Motor Drive Quick Change Gear Precision Lathe.

10″ swing 1″ Collet South Bend Tool Room Underneath Motor Drive Precision Bench Lathe.



10″ swing 11/16″ Collet South Bend Underneath Motor Drive Quick Change Gear Precision Lathe.

9″ swing Model A South Bend Workshop Quick Change Gear Precision Bench Lathe.

THE importance of selecting the *Right* lathe for every shop need is emphasized today by the demand for increased production resulting from our national emergency. Maximum production at minimum cost can be attained only when the lathe is matched perfectly with the job.

Consider the work to be done, then choose the size and type of lathe that will give the most efficient service. Remember that versatility and precision are important in a tool room lathe. For manufacturing operations, a lathe must also have plenty of power, speed, and stamina.

South Bend Lathes are made in a variety of sizes and types that will efficiently handle a wide range of metal working requirements. They can be supplied with equipment for precision tool room work, manufacturing operations, general machine work, and for many special classes of service.

Consult our Engineering Department about the lathe best suited to your work. We do no special tooling, make no special machines, but we will gladly give you our recommendation. A copy of our new Catalog No. 100A describing all sizes and types of South Bend Lathes will be sent on request.

ON DISPLAY IN ALL PRINCIPAL CITIES

BALTIMORE, MD.—Carey Machinery & Supply Co.
BOSTON, MASS. — South Bend Lathe Works †
BRIDGEPORT, CONN.— A. C. Bisgood
BUFFALO, NEW YORK—R. C. Neal Company, Inc.
CHICAGO, ILL. — South Bend Lathe Works ‡
CLEVELAND, OHIO — Reynolds Machinery Co.
HOUSTON, TEX.—Wessendorff, Nelms & Company
LOS ANGELES, CAL.—Eccles & Davies Mach. Co.
MILWAUKEE, WIS.—W. A. Voell Machinery Co.
NEWARK, N. J.—J. R. Edwards Machinery Co.
NEW ORLEANS, LA.—Dixie Mill Supply Co., Inc.
NEW YORK, N. Y.—A. C. Colby Machinery Co.
PHILADELPHIA, PA. — W. B. Rapp, Machinery
PITTSBURGH, PA. — Tranter Manufacturing Co.
PROVIDENCE, R. I. — Geo. T. Reynolds & Son
ROCHESTER, NEW YORK — Ogden R. Adams
SAN FRANCISCO, CAL. — Moore Machinery Co.
YORK, PA.—York Machinery & Supply Company

WE FAVOR ADEQUATE PREPAREDNESS FOR NATIONAL DEFENSE

†BOSTON Sales Office: 67 Broadway, Kendall Square, Cambridge, Mass., Phone Trowbridge 6369.
‡CHICAGO Sales Office: Room 308, Machinery Sales Building, Phone State 7283.

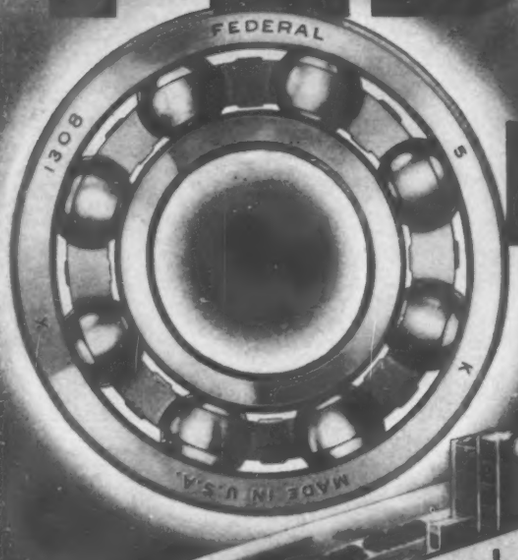
SOUTH BEND LATHE WORKS

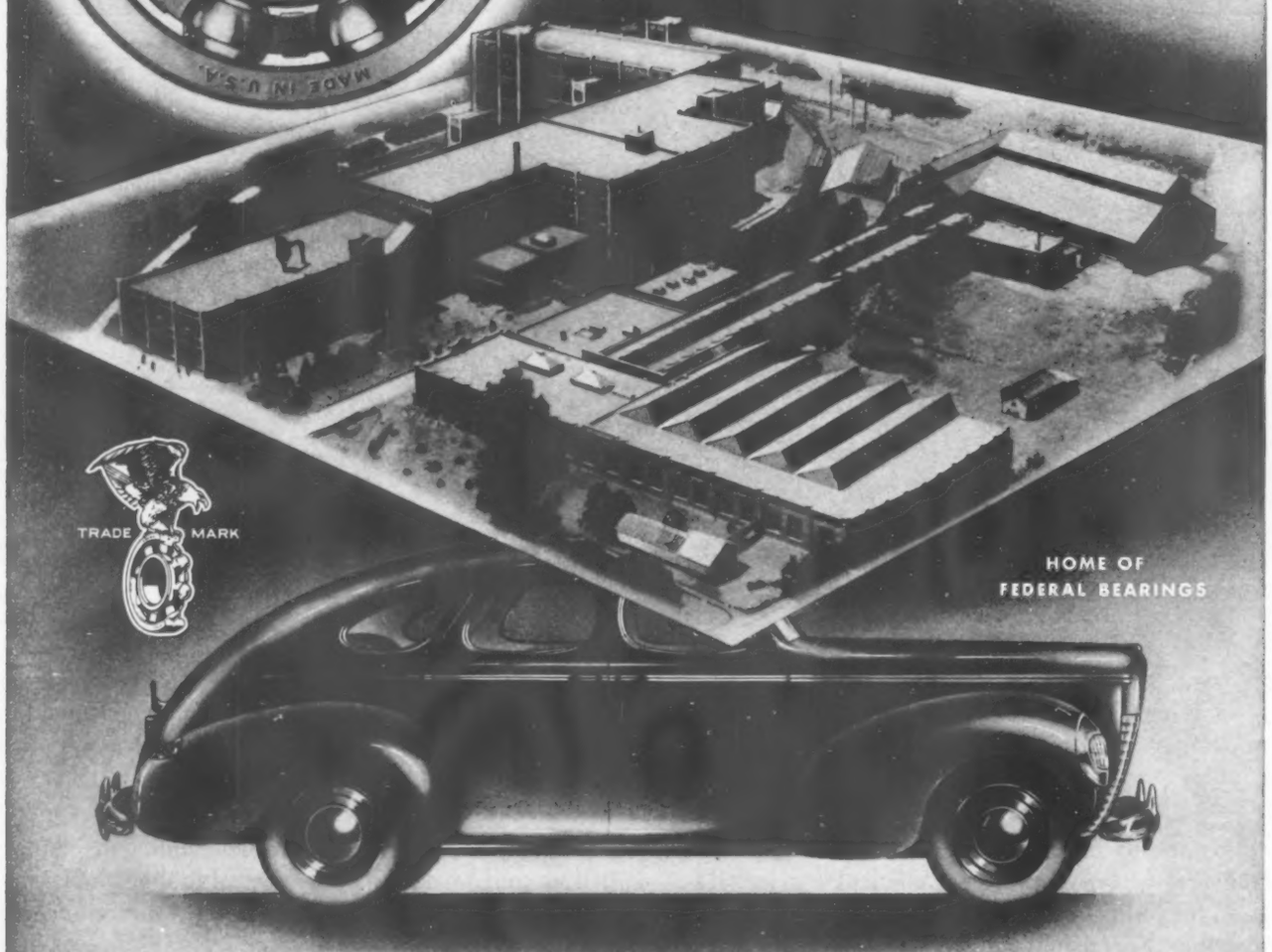
TRADE MARK SOUTH BEND TWING

LATHE BUILDERS SINCE 1906

291 E. Madison St., South Bend, Ind., U. S. A.

FEDERAL BEARINGS





TRADE MARK

HOME OF FEDERAL BEARINGS

THE FEDERAL BEARINGS CO., INC.

Makers of Fine Ball Bearings

POUGHKEEPSIE, N. Y.

Detroit Sales Office: 2608 Book Tower • Chicago Sales Office: 902 S. Wabash Ave.
Cleveland Sales Office: 402 Swetland Building

WHAT ARE YOUR REQUIREMENTS?

Mirror finish? Grey finish? Finish within 3 or 4 micro-inches? Absolute straightness and roundness? High production? Take a tip from the aircraft engine manufacturers—here, where finish, accuracy, and production are of such vital importance, Bryant Internal Grinders are the recognized choice. Overhead wheel slide, massive construction, rigidity, and ease of operation are features that are writing a new cost and production story in the aircraft industry. Let Bryant estimate the cost and production story on your own work—there is no obligation.

BRYANT CHUCKING GRINDER CO.
Springfield, Vermont, U. S. A.

SERIES 24 BRYANT
INTERNAL GRINDER

If You Must Act *Quickly* to Boost Plant Capacity ...or to Reduce Unit Costs

EXTRA output is being accomplished in many plants by reducing the number of times tools interrupt or slow down production. It is equivalent to adding new capacity—but easier, faster and cheaper. It's surprising how frequently a tool will gall, throw up a burr, wear beyond tolerance, lose its keen cutting edge, or otherwise force a shutdown of the equipment until it can be repaired or replaced. Several hours may be lost each time this happens.

It's equally surprising how frequently such tool troubles can be avoided. Ordinarily, they are traceable to nothing more than—

1. A choice of tool steels that just missed the bull's-eye.
2. Some difficulty in determining exact hardening procedures.

Facts are the remedy—facts plus a *simplified method for applying them* to each tool. Give your tool maker all the facts he needs to become as good a "sharpshooter" on tool steel selection as the "mill expert." Put in his hands exact hardening data and instructions for heat treating each tool steel. You can count on his doing the rest—making each of your tools better, more productive, less apt to fail or wear out prematurely.

All the information you need to put such a program into effect is down in black and white—*ready, waiting, proved* by application in thousands of tool rooms. Let Carpenter's new booklet, "Spotlighting Hidden Plant Capacity," tell you how Carpenter can help you initiate the "Matched Set Program" in your plant. In 14 minutes' reading time, this book will give you the fundamentals of the plan and illustrate with examples from practice the results you can expect.

Without obligation, write today for this "blueprint" to *extra* plant capacity.

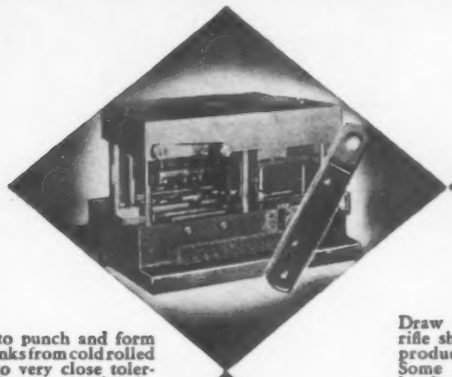
Bring Your Tool Steel Selection Problems to Carpenter's "Magic Mirror" — Machine and Tool Progress Exhibition, Detroit, March 25th to 29th.

Carpenter

BRANCH WAREHOUSES AT—Chicago, Cleveland, Detroit, Hartford, St. Louis, Indianapolis, Philadelphia,

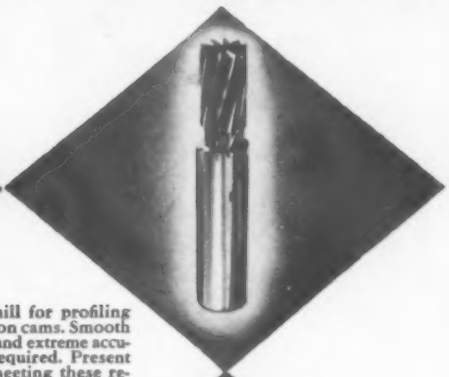
THE CARPENTER STEEL COMPANY

How Would You Prevent Interruptions in Service from These Tools?*

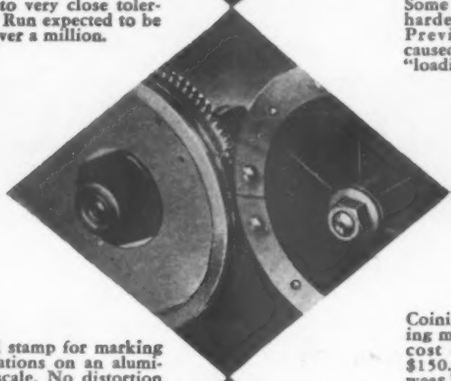


A die to punch and form short links from cold rolled stock to very close tolerances. Run expected to be well over a million.

Draw dies for brass rifle shells. Very high production required. Some "shrinkage" in hardening desirable. Previous dies have caused trouble from "loading up."

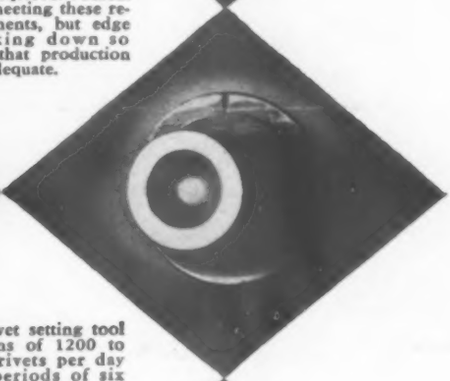


End mill for profiling cast iron cams. Smooth finish and extreme accuracy required. Present tool meeting these requirements, but edge breaking down so soon that production is inadequate.



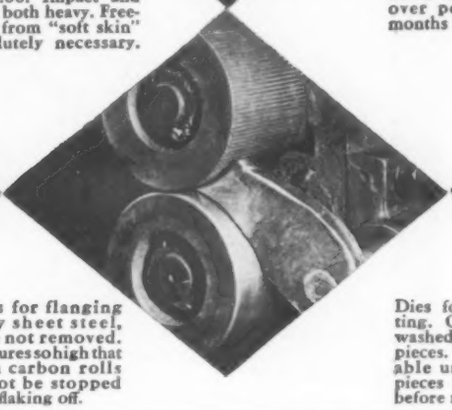
A roll stamp for marking graduations on an aluminum scale. No distortion or size change permissible. Medium run expected, pressures high.

Coining die for stamping medals. Engraving cost expected to be $150.00. Impact and wear both heavy. Freedom from "soft skin" absolutely necessary.

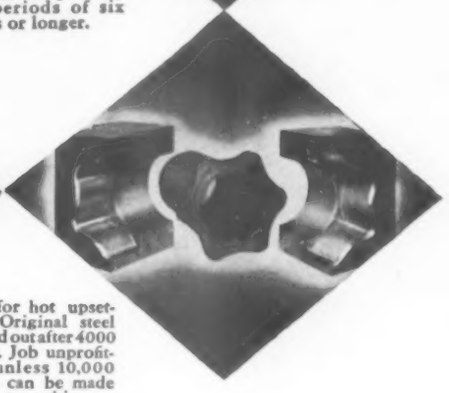


Hot rivet setting tool for runs of 1200 to 1500 rivets per day over periods of six months or longer.

Indexing ring to hold dental burrs while trade marks are stamped. Tolerances are close. Every steel tried has cracked or worn out. 2,000,000 runs required.



Rolls for flanging heavy sheet steel, scale not removed. Pressures so high that plain carbon rolls cannot be stopped from flaking off.



Dies for hot upsetting. Original steel washed out after 4000 pieces. Job unprofitable unless 10,000 pieces can be made before reworking.

HAMPDEN	K-W	STAR-ZENITH
STENTOR	11 SPECIAL	D. Y. O.
R. D. S.	SOLAR	EXCELO

***HERE ARE THE ANSWERS.** Behind these nine Carpenter Matched Tool Steels is a whole *program* for getting *better* tools—tools that produce more before they must be reground, repaired or replaced—tools that will *prevent* interruptions to production, and measurably increase plant capacity. Give your tool makers this opportunity to relieve the pressure on your production line. Send for our new booklet, "Spotlighting Hidden Plant Capacity."

FREE to tool steel users in U.S.A.

MATCHED TOOL STEELS

READING, PA.

THE CARPENTER STEEL COMPANY
109 Bern Street, Reading, Pa.

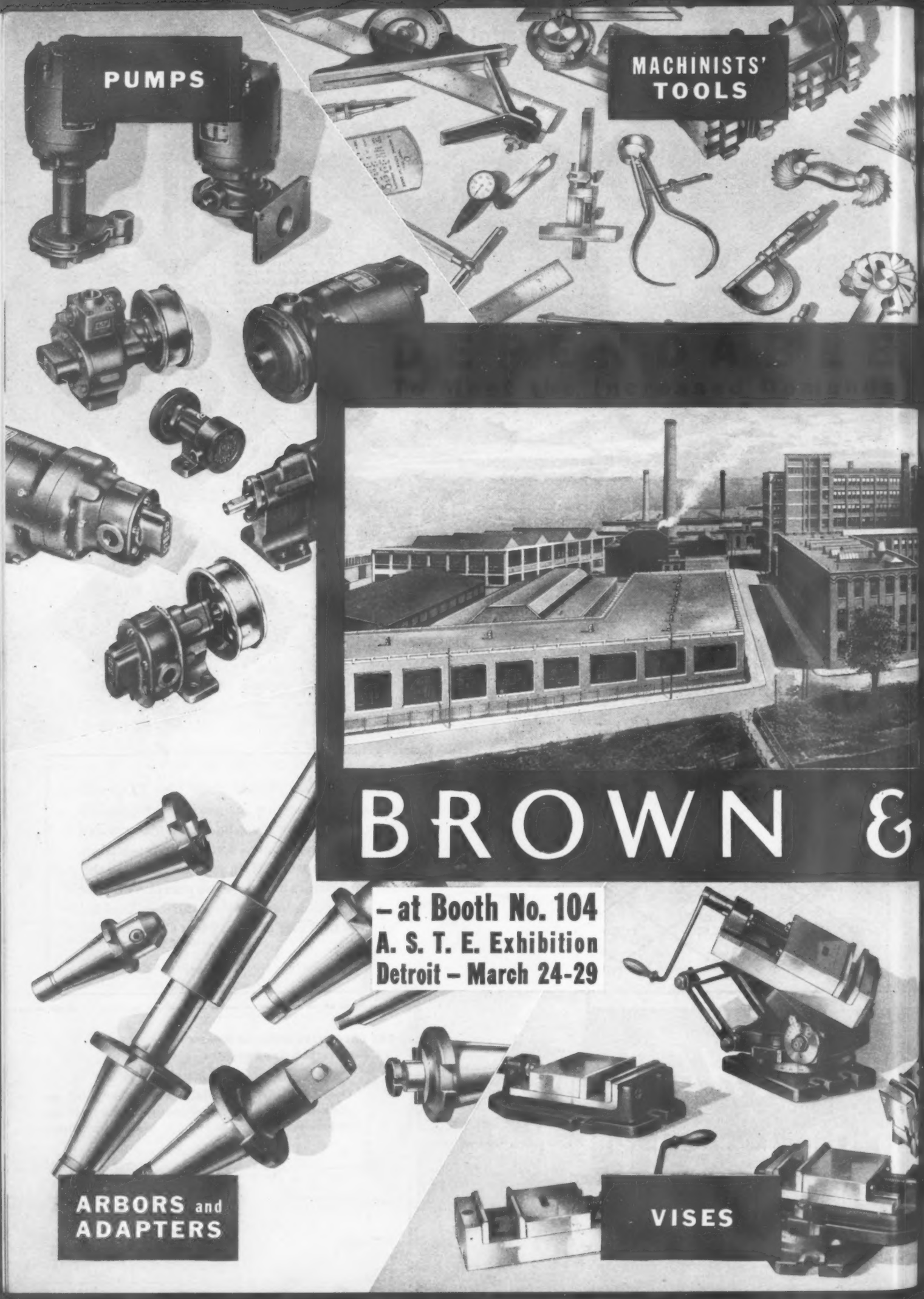
Gentlemen: Without obligation, please send me your free booklet describing your program for improving tools and stepping up machine capacities.

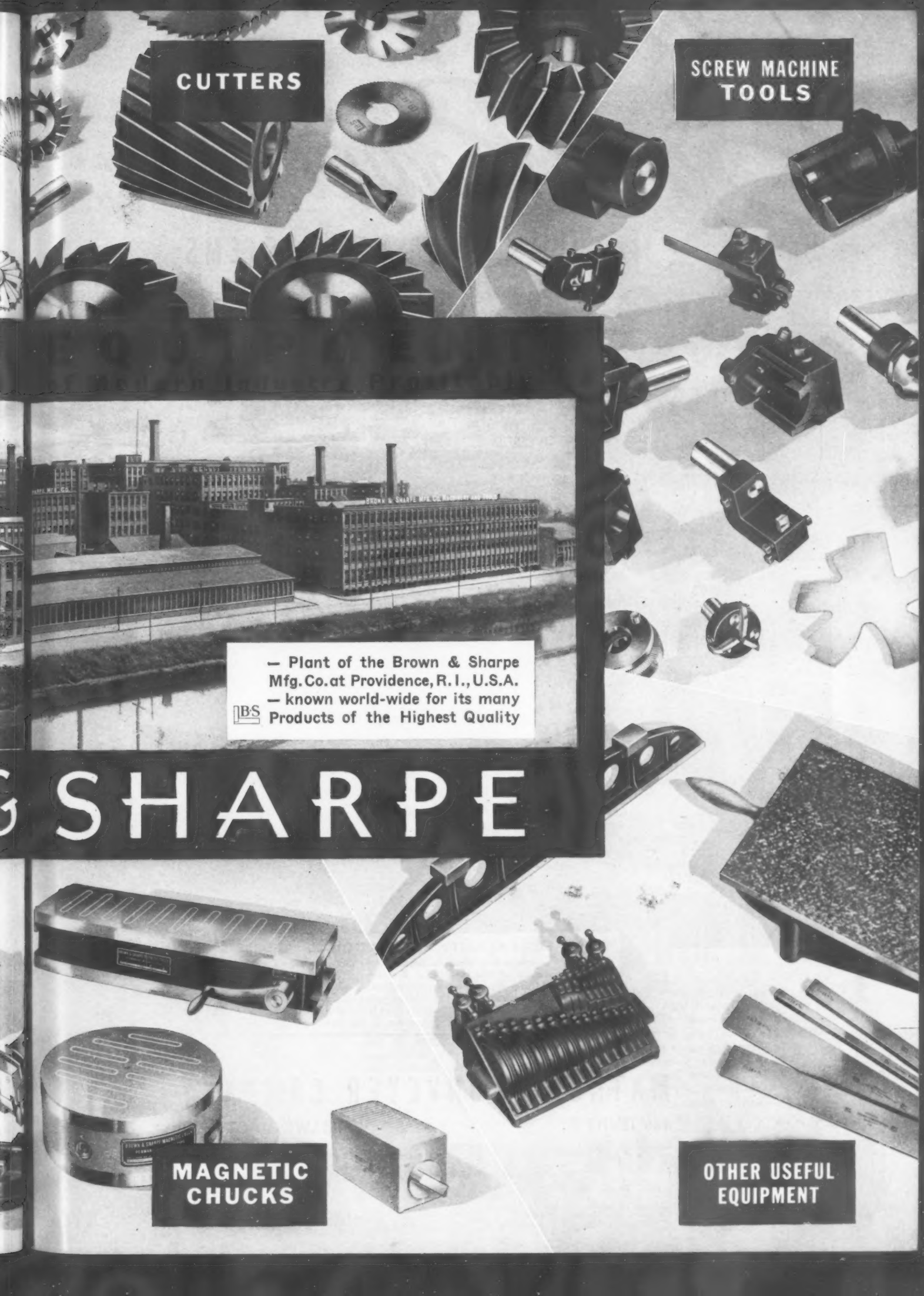
NAME _____ TITLE _____
(Please Print)

FIRM _____
(Firm Name Must Be Given)

ADDRESS _____

CITY _____ STATE _____


PUMPS
MACHINISTS' TOOLS
BROWN &
– at Booth No. 104
A. S. T. E. Exhibition
Detroit – March 24-29
ARBORS and ADAPTERS
VISES


CUTTERS
SCREW MACHINE TOOLS
— Plant of the Brown & Sharpe Mfg. Co. at Providence, R. I., U.S.A. — known world-wide for its many Products of the Highest Quality
SHARPE
MAGNETIC CHUCKS
OTHER USEFUL EQUIPMENT

Speed Production WITH

MATHEWS CONVEYER SYSTEMS

● To increase the efficiency with which materials and products are handled between processes in manufacture is to increase production. Better still, it means increased production with a reduction in worker fatigue — an important item if manpower is part of your manufacturing problem.

During the past 10 years there have been many new ideas developed in the field of materials handling. Why not call in the trained Mathews Field Engineer in your vicinity and take advantage of his experience in solving conveying problems similar to yours. Write or wire today!

INCREASED CAPACITY FOR NATIONAL DEFENSE

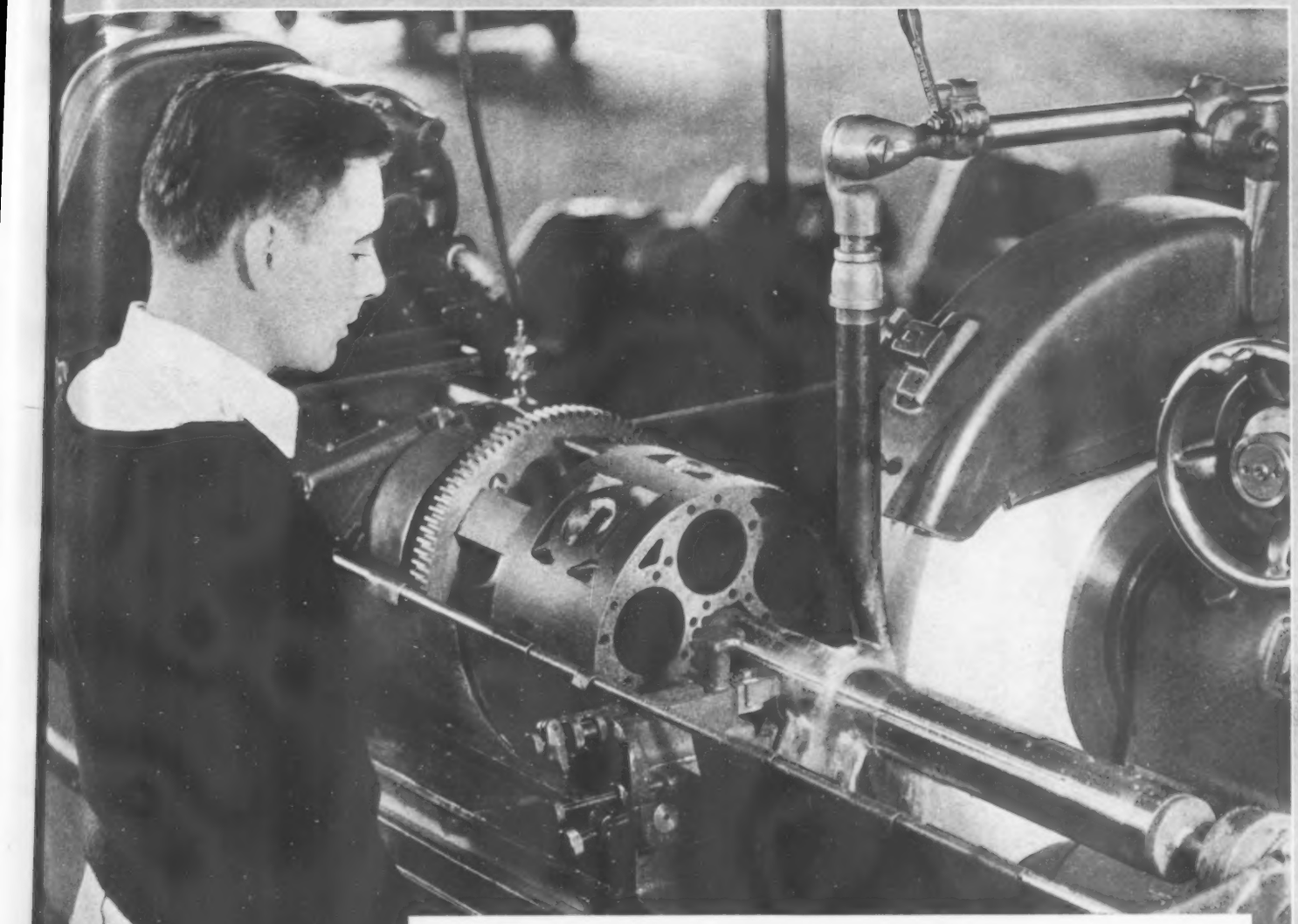
Our plant capacity has been increased over 65% to care for the rising demands of the National Defense Program — plus the normal demands of peacetime production.

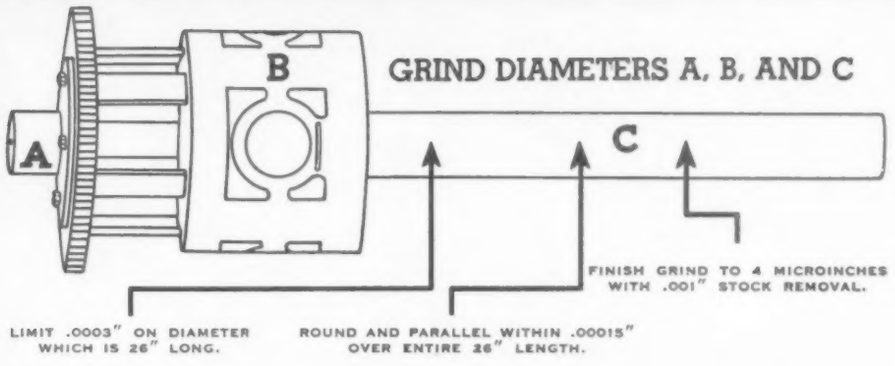
All orders, whether subject to Defense priorities or not, are given the same helpful care and attention that have always marked our dealings with prospects and customers in the past.

MATHEWS CONVEYER COMPANY

136 TENTH ST. - - - - ELLWOOD CITY, PA.

Field Engineers and Sales Offices located in 30 Industrial Centers



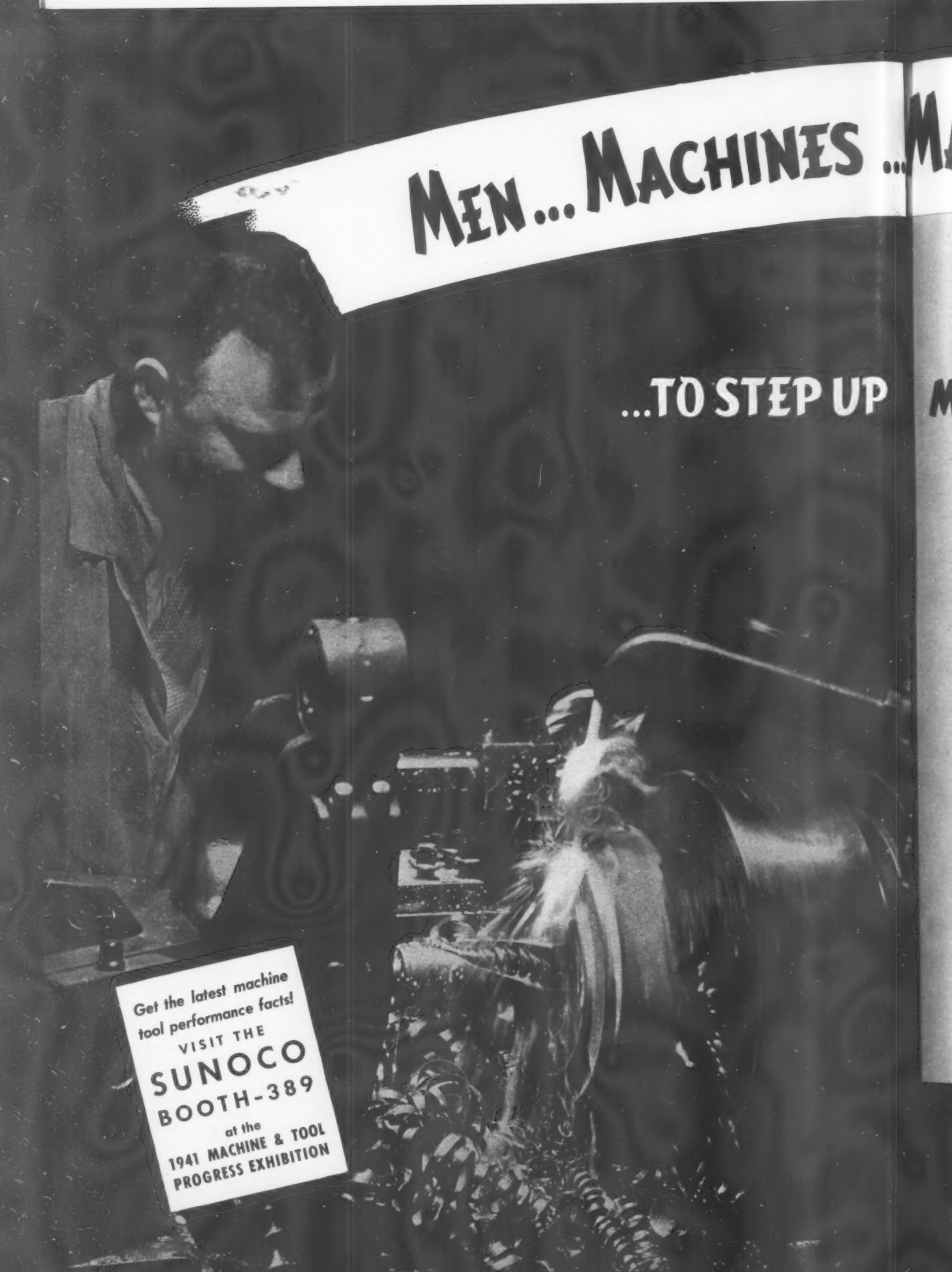

B
A
C
GRIND DIAMETERS A, B, AND C
FINISH GRIND TO 4 MICROINCHES WITH .001" STOCK REMOVAL.
LIMIT .0003" ON DIAMETER WHICH IS 26" LONG.
ROUND AND PARALLEL WITHIN .00015" OVER ENTIRE 26" LENGTH.

SEVERE REQUIREMENTS
• • MET BY LANDIS • •

Recently a Landis 14" x 48" Type C Plain Hydraulic grinder was installed in the plant of a well known machine tool manufacturer in Connecticut. There it is being used to rough and finish grind carrier assemblies and is satisfactorily meeting very severe performance requirements. ○ ○ ○ Three diameters are ground on the carriers, of which one, the stem, is first rough ground removing .030" stock. The two other diameters are then ground to a good commercial finish after which the grinding wheel is changed for the finish grind on the stem. About .001" stock is removed within a limit of .0003"; however, the stem must be round and parallel within .00015" over its entire 26" length. A surface finish of 4 microinches is required. ○ ○ ○ Such satisfactory results on a job so demanding invite your investigation. Why not give Landis a chance to meet YOUR requirements?

363

LANDIS TOOL CO.
WAYNESBORO, PENNSYLVANIA.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Get the latest machine tool performance facts!
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1941 MACHINE & TOOL
PROGRESS EXHIBITION

...MANAGEMENT... RELY ON SUNOCO

MACHINE TOOL OUTPUT

In every type of plant . . . under all kinds of working conditions SUNOCO is the choice of leaders in the metal working industry.

SKILLED MECHANICS are quick to appreciate that SUNOCO Emulsifying Cutting Oil has the qualities so vital in a cutting lubricant to provide ease of operation and fast accurate trouble-free production.

MACHINE TOOL production at "rated capacity" is made possible by SUNOCO's high lubricating and heat absorbing qualities. It prevents the tools from chipping or burning and permits heavy cuts at high speeds and helps to establish new highs in machine tool efficiency.

WORKS MANAGERS know that when it is essential to maintain present day production schedules SUNOCO Emulsifying Cutting Oil will aid in reducing waste production time . . . material . . . and man hours.

On performance and performance alone SUNOCO has won recognition. Test SUNOCO in your own shop . . . under your own working conditions and you'll know why "IT'S THE CHOICE OF THE LEADERS OF INDUSTRY." For full information, write

SUN OIL COMPANY, Philadelphia

Fast stock removal without increasing wheel wear is possible with SUNOCO.

Milling cutters will not burn, chips will not seize and cuts will be clean and even when SUNOCO is used.

Clean cuts and high efficiency in machine tool output may be established with the use of SUNOCO.

SUNOCO
EMULSIFYING
CUTTING OIL

TONS
of Johnson *Quality*
UNIVERSAL BRONZE BARS

Immediately from STOCK

One bar . . . a hundred bars . . . or tons of bars . . . right off the shelf into your shop with no delay. Over 350 sizes—cored and solid—enables you to order *exactly* to your requirements. Complete machining—inside diameter—outside diameter—ends—saves you time, tools and purchase weight; protects you against hidden defects.

And it's quality bronze too! Cast in S.A.E. 64—the best general purpose bearing bronze available. Try this remarkable service on your next order. Complete stocks are carried in every industrial center. Give us an opportunity to prove our exceptional service. UNIVERSAL Bronze will prove its quality through performance.

FREE

CATALOGUE

New from cover to cover . . . listing and describing the most complete bearing service in the world. Write for your free copy.

CARRIED IN STOCK BY YOUR LOCAL DISTRIBUTOR

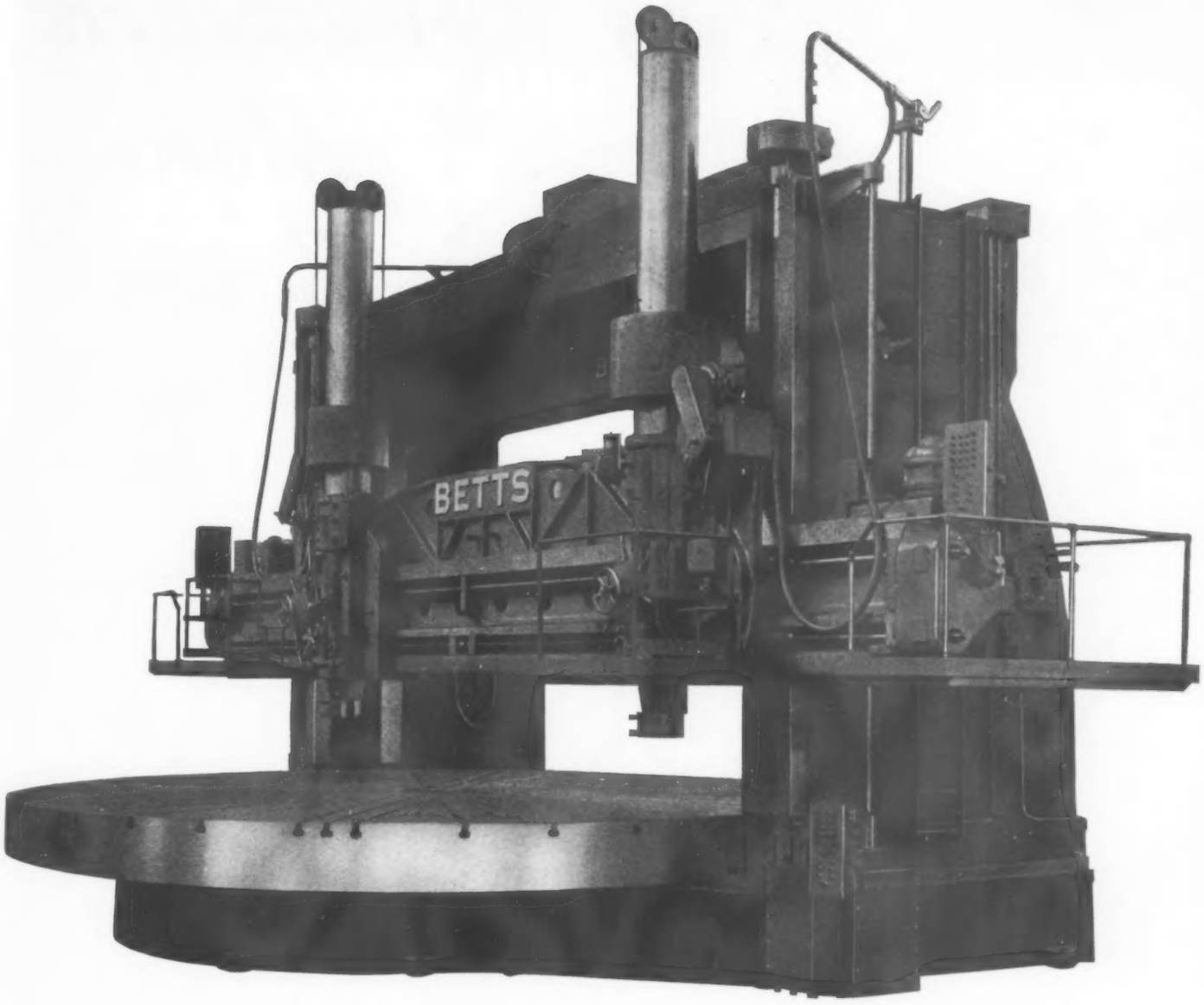
The most complete SLEEVE BEARING SERVICE in the world

JOHNSON BRONZE COMPANY

Sleeve BEARING HEADQUARTERS

515 SOUTH MILL STREET • NEW CASTLE, PA.

AT WORK ON DEFENSE NEEDS



Here's help for the National Defense Program. This recently built BETTS 25' Heavy Duty Boring Mill is already at work on important defense needs. And like other BETTS and COLBURN Boring Mills, it is doing accurate work and will continue to do so throughout its long life.

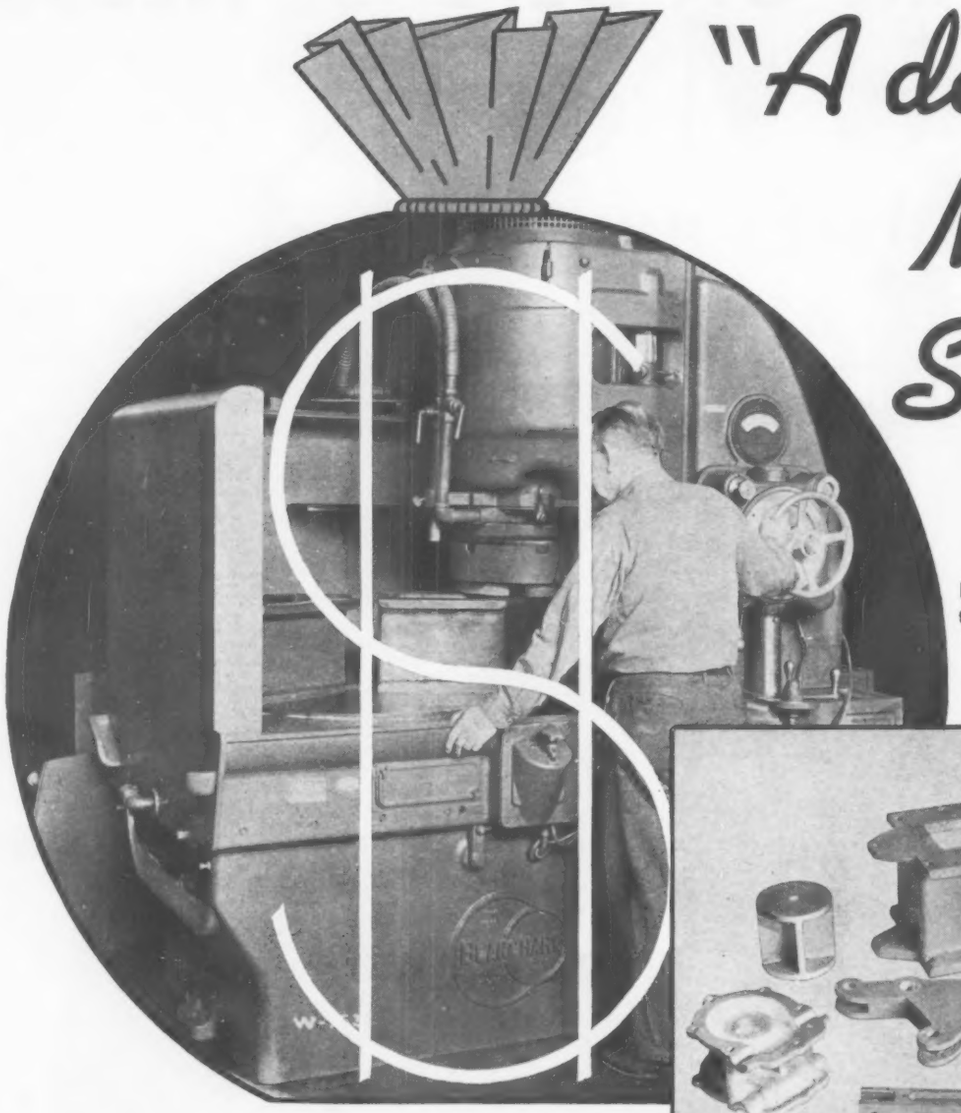
Consolidated design and construction which embody exclusive features and new developments insure the maintenance of original accuracy.

Whether you are engaged in the Defense Program or in the equally important program of building those products that help maintain the American standard of living, Consolidated Machine Tools help you to do your part better, quicker and more economically.

BETTS • BETTS-BRIDGEFORD • NEWTON • COLBURN • HILLES & JONES • MODERN

CONSOLIDATED
MACHINE TOOL CORPORATION
ROCHESTER, NEW YORK

"A decided Money Saver"



No. 18 Blanchard with 6" extended column for work 18" maximum height.

Miscellaneous parts like these are a "natural" for Blanchard Grinders.

Routing miscellaneous parts in small quantities is a problem in any plant—until they come to Blanchard Surface Grinders. "A decided money saver" is what the manufacturer of these pump parts called his No. 18 Blanchard. This is a machine designed not only for production, accuracy, and fine finish, but for quick changeover from job to job. Chucking the work is made easy by the Blanchard One-Piece Steel Magnetic Chuck. Convenient controls make the setting and operation of the machine quick and almost effortless. If you decide to put a "money saver" in your plant, write to Blanchard to find out just what these savings will be.

BLANCHARD

THE BLANCHARD MACHINE COMPANY
64 STATE STREET, CAMBRIDGE, MASSACHUSETTS, U. S. A.

LONG DIES... *THIN SECTIONS,*
A TOUGH BLANKING JOB... BUT

Air Hard *ATE IT UP*

Blanking and notching S.A.E. 1010 stock, .065" thick, can be really tough on dies and punches like these—unless AIR HARD is used. Because, with this great VASCO steel, long runs are routine—movement is nil—trouble stays safely away. (Say "AIR HARD" to the VASCO man, and let him show *you* the difference!)

Vanadium-Alloys STEEL CO. LATROBE, PA.

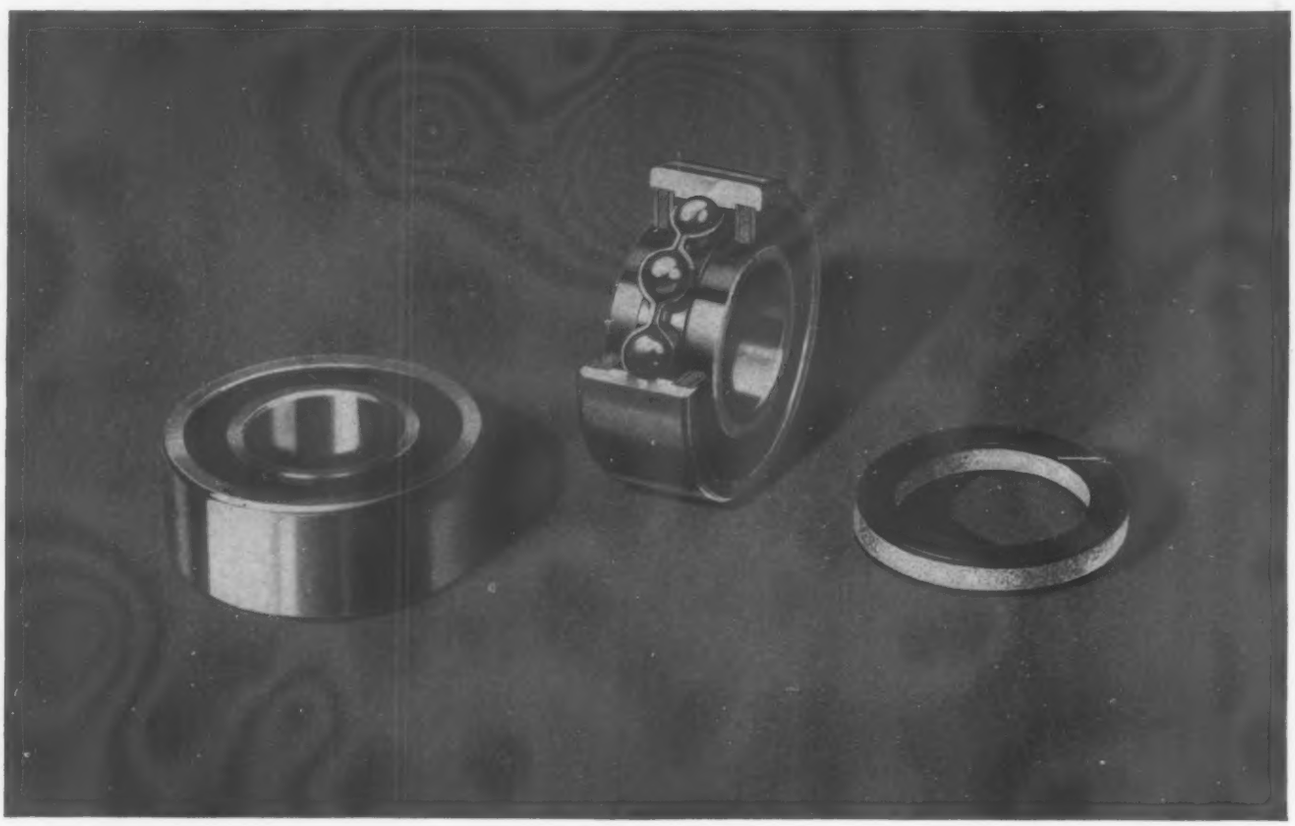
TOPS IN TOOL STEELS

"NORMA-HOFFMANN"

Felt Seal Ball Bearings with

REMOVABLE, REPLACEABLE SEALS

are not only **SMOOTH AND QUIET,** *but also* **EASY TO INSPECT AND REGREASE**



Rigidly fixed in the outer ring, the felt seals in NORMA-HOFFMANN PRECISION BEARINGS are nevertheless easily and quickly REMOVABLE AND REPLACEABLE at will, thus facilitating inspection, cleaning or regreasing.

Moreover, the seal is entirely within the confines of the bearing, and therefore not exposed to injury. The NORMA-HOFFMANN seal construction avoids race distortion, assuring dimensional accuracy and quiet running.

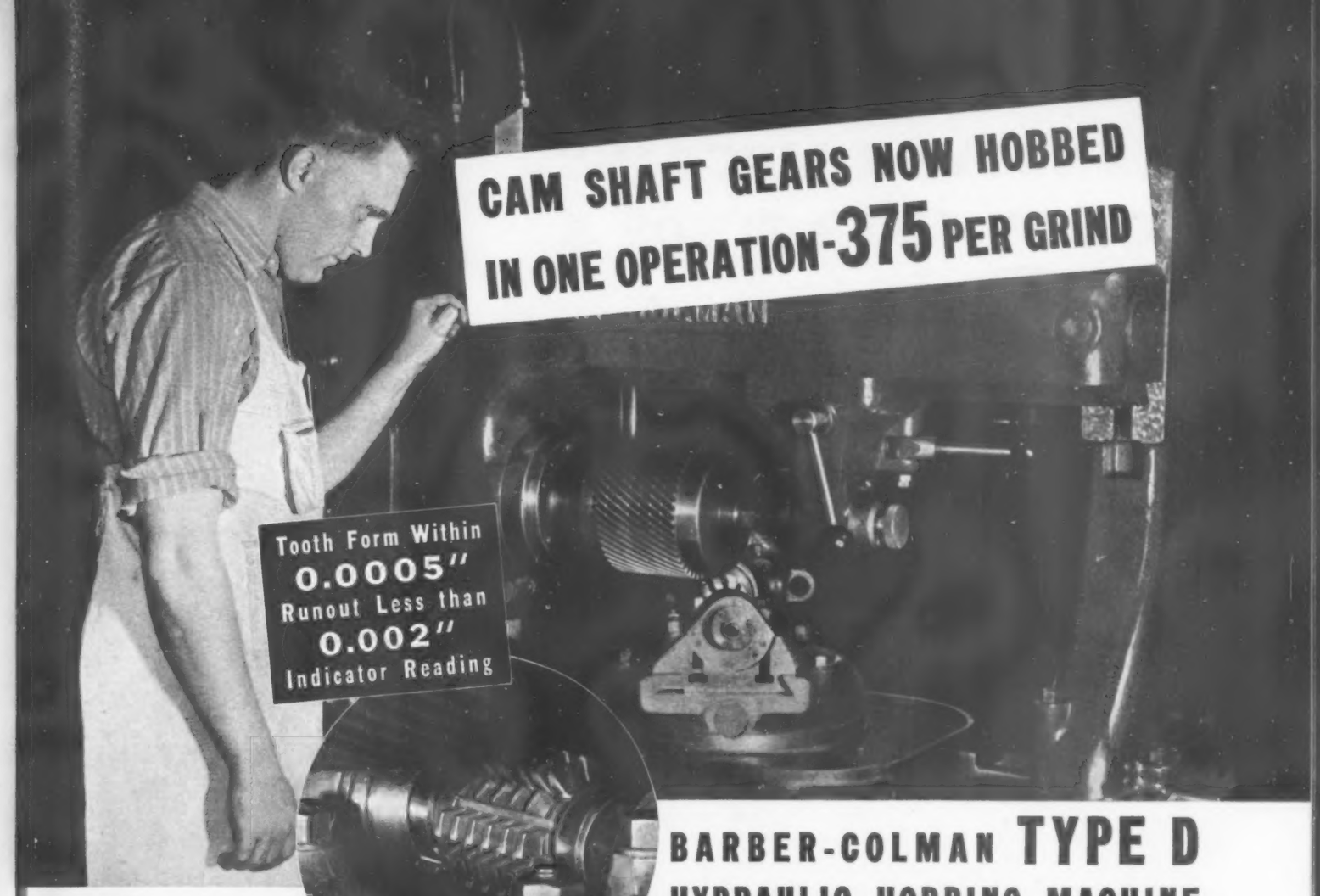
The effective labyrinth formed by the THICK, FULL-SIZE FELT SEALS and plates against the recessed inner ring, provides extra protection against escape of lubricant or ingress of dirt. Grease capacity is ample for long service.

Wide, solid inner and outer rings afford maximum contact on shaft and in housing—making housing inserts unnecessary and militating against slippage, looseness, and escape of lubricant past outer ring.

Write for the Catalog, describing the most complete line of self-sealed bearings in America, including several series with single felt seal, with single felt seal and side plate, and with double felt seal (illustrated above).

NORMA-HOFFMANN BEARINGS CORPN., STAMFORD, CONN. U.S.A.

CAM SHAFT GEARS NOW HOBBED IN ONE OPERATION-375 PER GRIND



Tooth Form Within 0.0005"
Runout Less than 0.002"
Indicator Reading

Note the fine finish and accuracy of these gears which were hobbed in the average floor-to-floor time of 40 minutes per load of 7.

BARBER-COLMAN TYPE D HYDRAULIC HOBBING MACHINE Cuts Costs on Cam Shaft Gears

A leading tractor builder furnishes this example of how Barber-Colman Hobbing simplifies precision operations, cuts costs and speeds work. Cam shaft gears produced on Barber-Colman Type D Hydraulic Hobbing Machines are held to precision tolerances and subsequent operations formerly required are eliminated. Seven gears constitute one load, and are hobbed in approximately 40 minutes floor-to-floor.

Powerful hydraulic actuation and rugged machine design combine to make the Type D unexcelled for high-production, heavy-duty hobbing. On this job, a taper hob spindle and B-C Ground Hob with taper bore contribute to both precision and easy, fast, set-up. Hobs may be located on the spindle with consistant accuracy. Runout error averages less than 0.002".

The Figures

Name of Part — Cam shaft gear. Material — Cast iron chrome alloy.
Operation — Hobbing spiral gears having 3/4" face, 7.953"—7.948" outside diameter, 46 teeth, 31° helix angle, 7 diametral pitch.
Number gears per load — 7.
Hobbing Machine — Barber-Colman Type D.
Hob Used — Barber-Colman Class A Ground Hob; 4 1/8" diameter by 5" long, with 2 1/2" taper hole; single thread; 15 gashes.
Hob Feed — 0.070" per rev. of work.
Hob Speed — 108 r.p.m.
Production — Average time, 40 minutes per load of 7.
Number of Settings — 3.
Pieces per Grind — 375.
Accuracy — Tooth form held within 0.0005". Runout less than 0.002" indicator reading.

Look into the advantages that Barber-Colman Complete Hobbing Service can bring you. Your request for information is without obligation.

• Illustrated Bulletin 1477 completely describes the numerous advantages of Barber-Colman Type D Hydraulic Hobbing Machines; with specifications. Write for your copy today.

BARBER B-C COLMAN
PRODUCTS
HOBS, HOBBING MACHINES, HOB SHARPENING MACHINES, REAMERS, REAMER SHARPENING MACHINES, MILLING CUTTERS, SPECIAL TOOLS

Barber-Colman Company

General Offices and Plant 201 Loomis St., Rockford, Illinois, U. S. A.

» » ANOTHER MACHINE TOOL BUILDER FINDS A *Profit-maker* IN CLEVELAND SINGLE SPINDLE AUTOMATICS

Builders of machine tools themselves, owners of this Rochester, New York plant recently installed a Model A Cleveland *Single Spindle* Automatic of 3¾-inch capacity. And again the flexibility and productive capacity of a Cleveland is making good from the start. Here are two typical jobs produced on it recently, as shown below.

Chuck Lever Fulcrum—cut from 2⅜-inch cold rolled SAE 1112 bar stock, in lots of 500 pieces, production is considerably greater than by previous methods. Operations consist of feeding out, drilling, rough forming, boring, skiving, reaming and cutting off.

Oil Ring Nut—cut from 2½-inch O.D. SAE 1120 steel tubing, in correspondingly small lots, production surpasses previous methods. Operations are feeding out, boring, forming, recessing, facing, reaming and cutting off.

The rugged construction of Model A is well known. Its accessibility for adjustment and ease of tooling up is unmatched. Cleveland *Single Spindle* Automatics today have the operating range that is required in current production schedules, and sufficient speed to more than meet demands. A four-speed motor is standard equipment.

If you have short runs of parts to produce, investigate the possibility that Model A offers for more economical production.

•

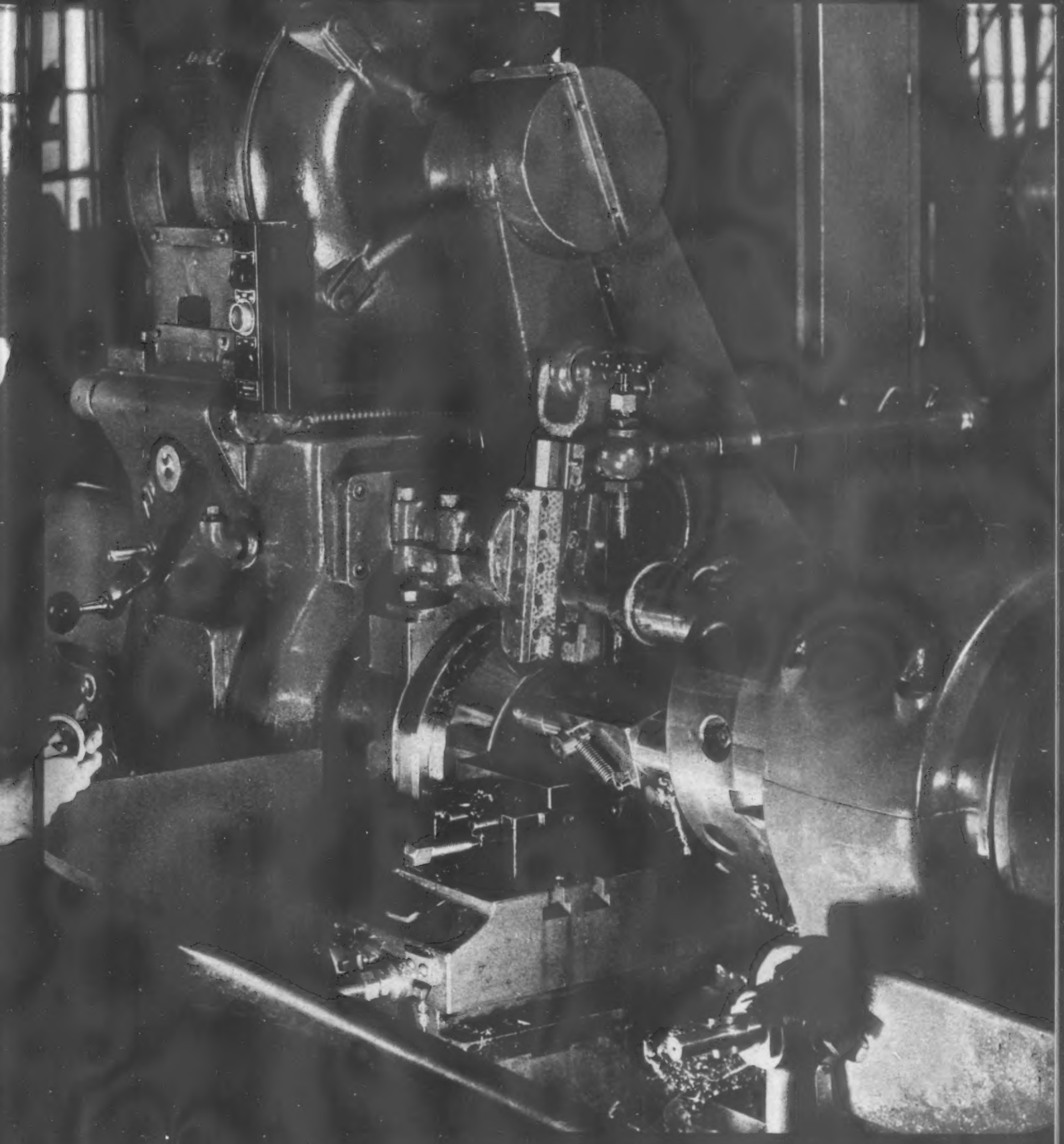
Model AA, Cleveland *Single Spindle* Automatics, are described in a ★ brochure sent on request. This new streamlined Cleveland is at work in many plants throughout the country, and making good in every one of them on small-lot production.

THE CLEVELAND AUTOMATIC MACHINE COMPANY
2269 ASHLAND ROAD • CLEVELAND, OHIO

Sales Offices: NEW YORK—50 Church Street • DETROIT—2842 Grand Boulevard
CHICAGO—565 West Washington Street • CINCINNATI—314 American Building

These are the parts referred to above, produced on Model A, 3¾-inch capacity, Cleveland *Single Spindle* Automatic. Parts are reproduced here about half-size.

★ Ask for your copy of this brochure describing Model AA



CLEVELAND

MODEL A *Single Spindle* AUTOMATIC

MODEL A—Built in 9/16-inch to 8-inch capacities inclusive

MODEL AA—Built in 1 1/16-inch and 1 3/8-inch capacities only

Squaring of both ends at one pass of the broach.

Deep slotting with removal of large amount of metal.

Small brass part with five accurate slots on circumference in one pass through broach.

Automotive steering knuckle which offers opportunity of several broaching operations.

If it's Production!

● When you need high production one of the various sizes of Footburt Surface Broaching Machines will give it to you. Machining of duplicate flat or curved surfaces can, on many parts, be handled faster, with better finish and accuracy, and with lower tool maintenance cost than with any other machining method. It will pay you to investigate Footburt surface broaching possibilities on your work.

THE FOOTE-BURT COMPANY

CLEVELAND, OHIO

Detroit Office:
4-151 General Motors Bldg.

Chicago Office:
20 North Wacker Drive

FOOTBURT *Surface* **BROACHING**

R.S.V.P.

PRATT & WHITNEY
Booth 129
DETROIT

THE PRATT & WHITNEY exhibit at Detroit . . . *Accuracy Headquarters* . . . is Booth 129 . . . on your left coming from the main entrance. Here are assembled the newest fine cutting tools and precision gages . . . and demonstrations of what they are doing in the national defense program. Come in and see our famous "diamond blue" treatment that has increased cutting ability and tool life so remarkably. Look over the precision gages that solved tough inspection problems of war level production. Examine the Kellerflex Flexible Shaft Equipment that replaces "muscle finishing" and speeds up the job. Come in at 129—*Accuracy Headquarters*. You will find a warm welcome . . . and all the help we can offer to solve your problems.

PRATT & WHITNEY

DIVISION NILES-BEMENT-POND COMPANY

SLOCO

. . . KEEPS PACE IN TOOL ROOM AND PRO D
TODAY'S DEMAND FOR SPEED IN PRECISION

SLOCOMB INSTRUMENTS today—as through the past fifty years—are recognized standards of comparison in precision measuring. As production has been stepped up and closer tolerances demanded, these dependable instruments have been developed to meet the more exacting conditions.

Tool rooms, production lines and inspection departments the world over recognize the superiority of Slocomb Micrometer Calipers for fast, precision measuring, ease of checking and maintained accuracy under constant hard usage.

Slocomb is prepared as always to supply instruments which through fast checking to high degrees of precision will be of outstanding assistance in facilitating production.

SLOCOMB MICROMETER CALIPER No. 22

A small sturdy instrument of high accuracy. Light in weight, weighing only 1¾ oz. Easy and convenient to handle and carry. Measures all sizes from 0 to ½ inch by thousandths. Made also in metric graduations. Available with plain or friction stop.

SLOCOMB MICROMETER SETS Nos. 22 and 28

Set #22—comprising 12 micrometers and 11 end measures—will handle work measurements from 0-12" by thousandths. Also available for metric measurements from 0-300 m.m. by 1/100 m.m.

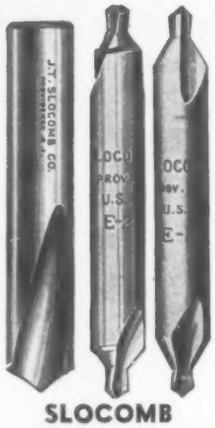
Set #28—(not shown) includes 12 micrometers and 11 end measures for measurement from 12"-24" by thousandths. Can also be supplied for measurements from 300-600 m.m. by 1/100 m.m.

Slocomb also furnishes standard micrometer sets for measurements from 24"-60" or 600 m.m.-1500 m.m.

J. T. SLO

OMB

DUCTION with
N MEASURING . .



SLOCOMB
CENTER DRILLS

Available in either carbon or high speed steel in Center Drill, Combination Center Drill and Bell Type Center Drill types. Sizes as follows: Center Drills from 1/8 to 1". Combination and Bell Type from 1/8 to 3/4".

OUTSTANDING FEATURES OF DESIGN AND CONSTRUCTION

Arrangement of nuts insuring long bearing in spite of wear.
Short nut—D to compensate for wear in threads.
No split in sleeve to admit dust and dirt and cause rapid wear.
Nut—C 5/8" long, twice as long as bearing in other micrometers. Can be replaced when worn.
.270" diameter screw and anvil. This gives 16½% more wearing surface at this point than .250" diam.
Solid inserted anvil—G.
I section frame—B drop forged from bar steel.
Black enameled or polished frame.
One piece hard tool steel screw—A.
Accurately fitting bushing—H insures close fit for screw. Replaceable.
Nickel silver spring E. Gives uniform tension on screw.
Adjusting nut—C to overcome wear on anvil or screw. Replaceable, giving entirely new bearing for screw.
Decimal equivalents stamped on thimble.
F—Thimble.

Send for
SLOCOMB
Catalog No. 18

FREE This 112-page catalog covers the complete SLOCOMB line and contains valuable information for machinists, shop men and inspectors on modern methods of checking tolerances. Write for your copy TODAY. No obligation of course.

SLOCOMB
SNAP GAUGE MICROMETERS

These instruments provide speed and accuracy and eliminate guesswork. Work can be gauged as it progresses. The use of these time savers in inspection or production eliminate the necessity for handling a wide variety of snap gauges.
Made in sizes from 0-1" to 11-12"; metric sizes from 0-25 m.m. to 275-300 m.m.

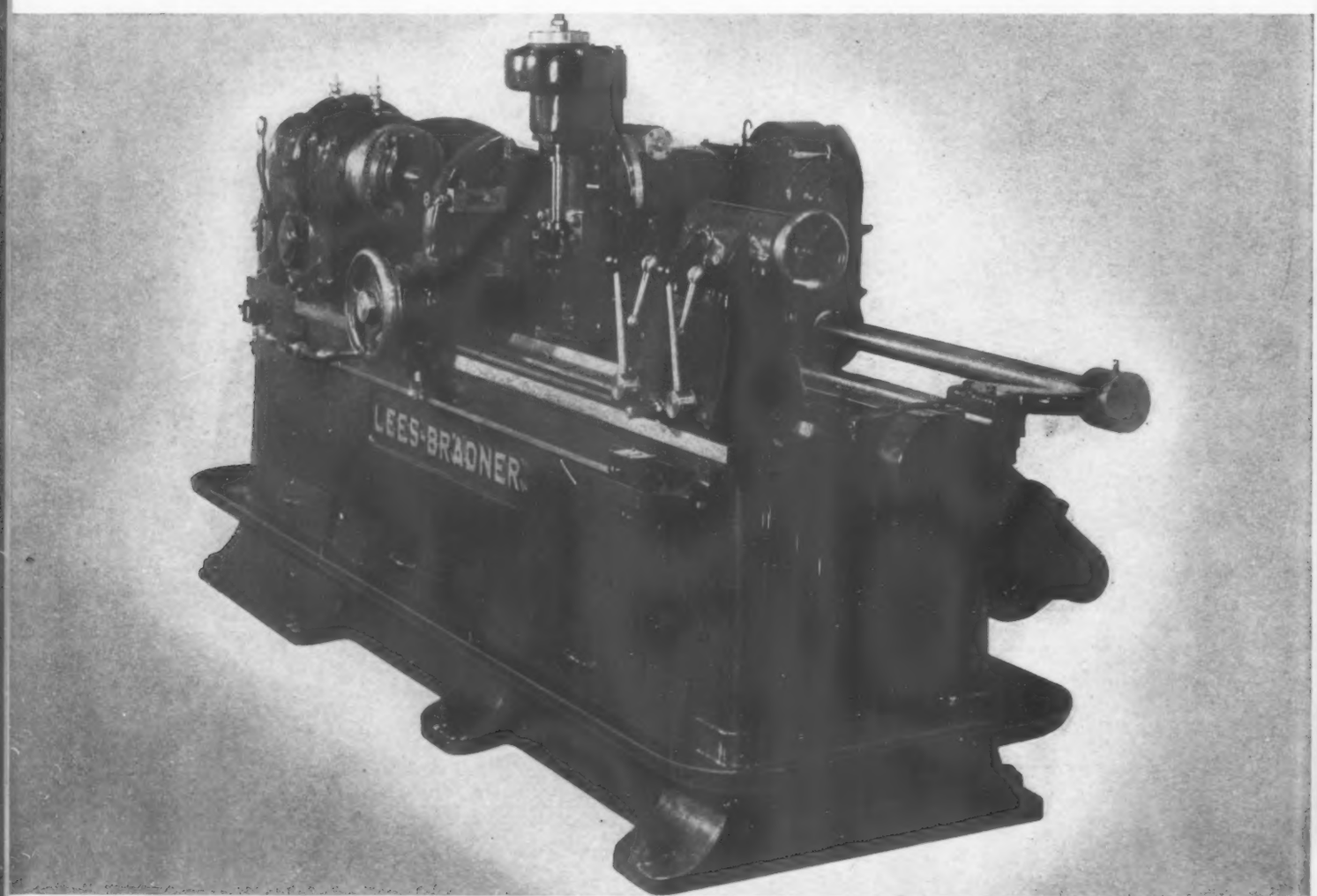
SLOCOMB PROVIDENCE RHODE ISLAND

THE LEES-BRADNER

MODEL SH

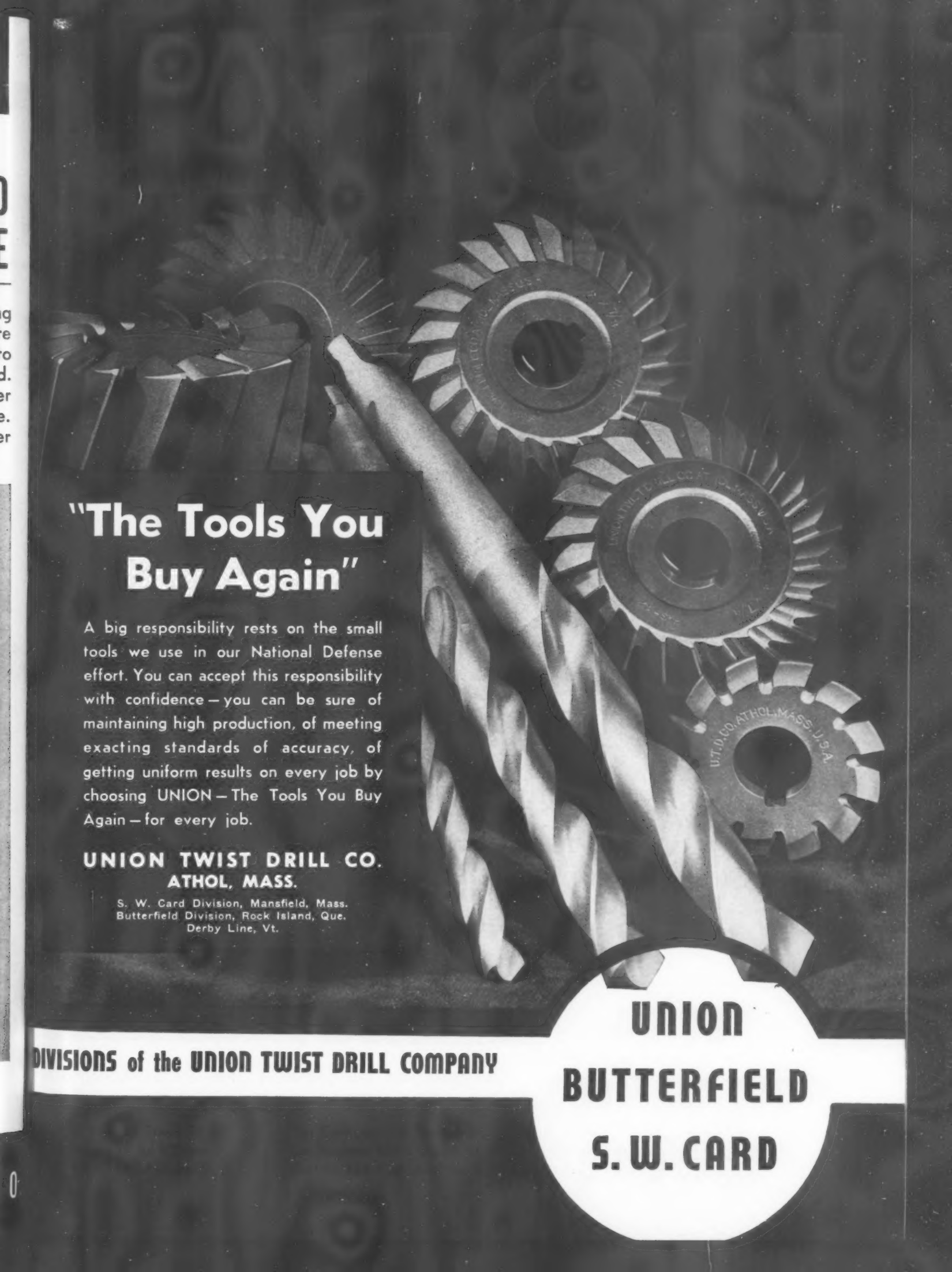
HORIZONTAL SPLINE AND GEAR HOBBING MACHINE

The Horizontal Spline Hobbing Machine, built by the pioneers of gear hobbing machines in this country, is the logical answer to the plant requiring the accurate generation of long, continuous splines. The machine is available in several lengths, to produce splines up to 102" of continuous length in one cut, or longer lengths if desired. Altho the Model SH Machine is intended primarily for the production of either straight or helical splines, spur and helical gears can be hobbed with equal ease. If desired, the machine can, on special order, be arranged with an extra cutter head for thread milling purposes.



Write us for our newly published Catalog, which illustrates and describes the full line of Lees-Bradner Machines. We also solicit specific inquiries. There is, of course, no obligation.

THE LEES-BRADNER CO., CLEVELAND, O



"The Tools You Buy Again"

A big responsibility rests on the small tools we use in our National Defense effort. You can accept this responsibility with confidence — you can be sure of maintaining high production, of meeting exacting standards of accuracy, of getting uniform results on every job by choosing UNION — The Tools You Buy Again — for every job.

UNION TWIST DRILL CO.
ATHOL, MASS.

S. W. Card Division, Mansfield, Mass.
Butterfield Division, Rock Island, Que.
Derby Line, Vt.

DIVISIONS of the UNION TWIST DRILL COMPANY

UNION
BUTTERFIELD
S. W. CARD

CARD

Don't judge taps on the basis of price—or performance—alone. Use the Card Service Test as your guide and let cost plus performance give you the true picture of tap value. And when you see the quality of work that Card Taps are consistently producing you'll standardize on Card for every tapping job.

S. W. CARD MFG. CO., MANSFIELD, MASS., U.S.A.

The CARD Quality

UNION
BUTTERFIELD
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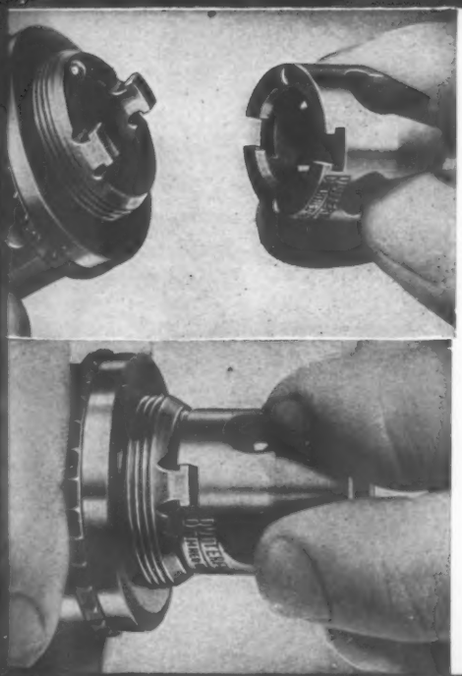
DIVISIONS of the UNION TWIST DRILL COMPANY

THRED-RITE DIES



The adjustable collet die at its best! The result of Butterfield's intensive research into ways to improve the tools of modern production.

"THRED-RITE" Dies are simple in construction, easy to assemble (see photographs) and quickly adjustable to split 0.001". Full floating construction insures accurately centered work.

Where speed is imperative – and the going is tough – put "Thred-Rite" Dies on the job. They have been tested under the severest operating conditions and have proved their capacity for taking on all sorts of hard jobs – accurate jobs! – and delivering the goods. A full stock of N.C. and N.F. series is available from any of our stores and agents listed below and from any Butterfield jobber.

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DIVISIONS of the UNION TWIST DRILL COMPANY

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BUTTERFIELD
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● Wherever there are PAGE ELECTRODES there is no bottleneck. Welders are getting better welds — more uniform welds — welds that pass careful inspection—and doing it in less time.

You will find your local PAGE Distributor well able to give you exact recommendations—supplemented by interesting booklets—on the electrodes that will give you the production you expect and need today.

PAGE HI-TENSILE "F"—High speed welding, a shield-arc type electrode for vertical, horizontal or overhead.

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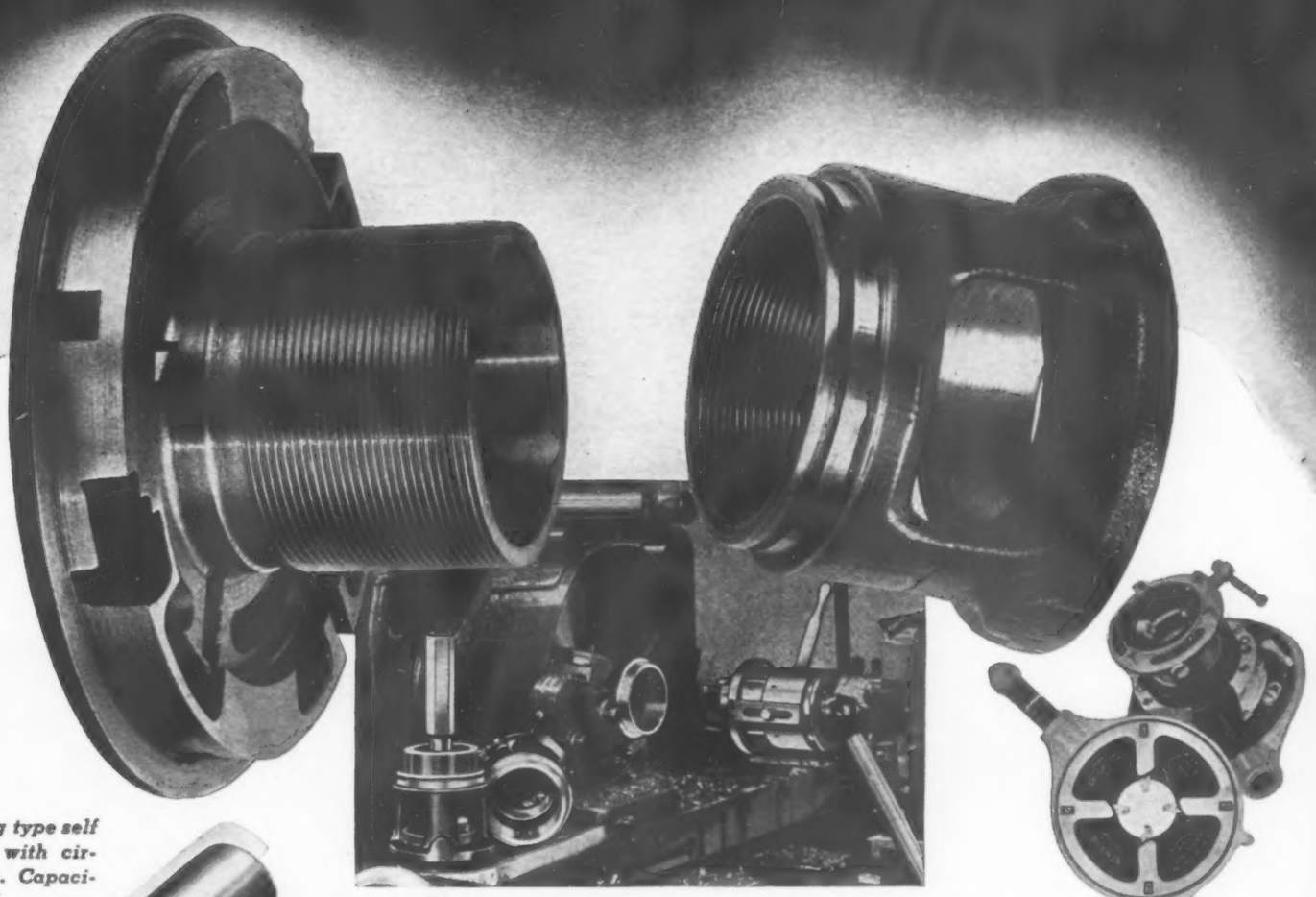
PAGE ELECTRODES

PAGE STEEL AND WIRE DIVISION • MONESSEN • PENNSYLVANIA

In Business for Your Safety

AMERICAN CHAIN & CABLE COMPANY, Inc.

NAMCO DIES AND TAPS *cut* LEAD SCREW *threads*



Non-revolving type self opening Die with circular chasers. Capacities 3/8 to 4 7/8".

Here are the facts—YOU be the judge

More "RIDGID" pipe die heads are sold than any other make threaded with Namco Dies and Taps. That speaks for their performance.

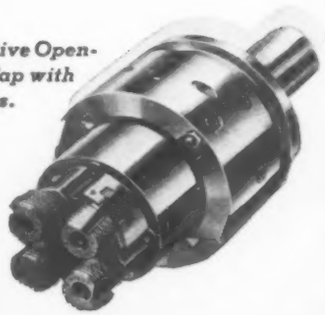
The time for tapping the malleable casting, 3¼" diameter hole, 1¼" long, is 45 seconds — with a Namco precision circular chaser Collapsing Tap.

The time for threading the male pieces, with a Namco circular chaser Self Opening Die, is 61 seconds. Formerly the thread on this piece was milled—in 4 minutes.

As to accuracy, Mr. Wm. Thewes, superintendent of Ridge Tool Co. says: "these threads are held to .0005" for the 1¼" length of their engagement—lead screw accuracy." And he adds, "scrap is practically nil—we couldn't afford it."

This is just one more proof of performance for savings with Namco Dies and Taps. What might they mean on YOUR work?

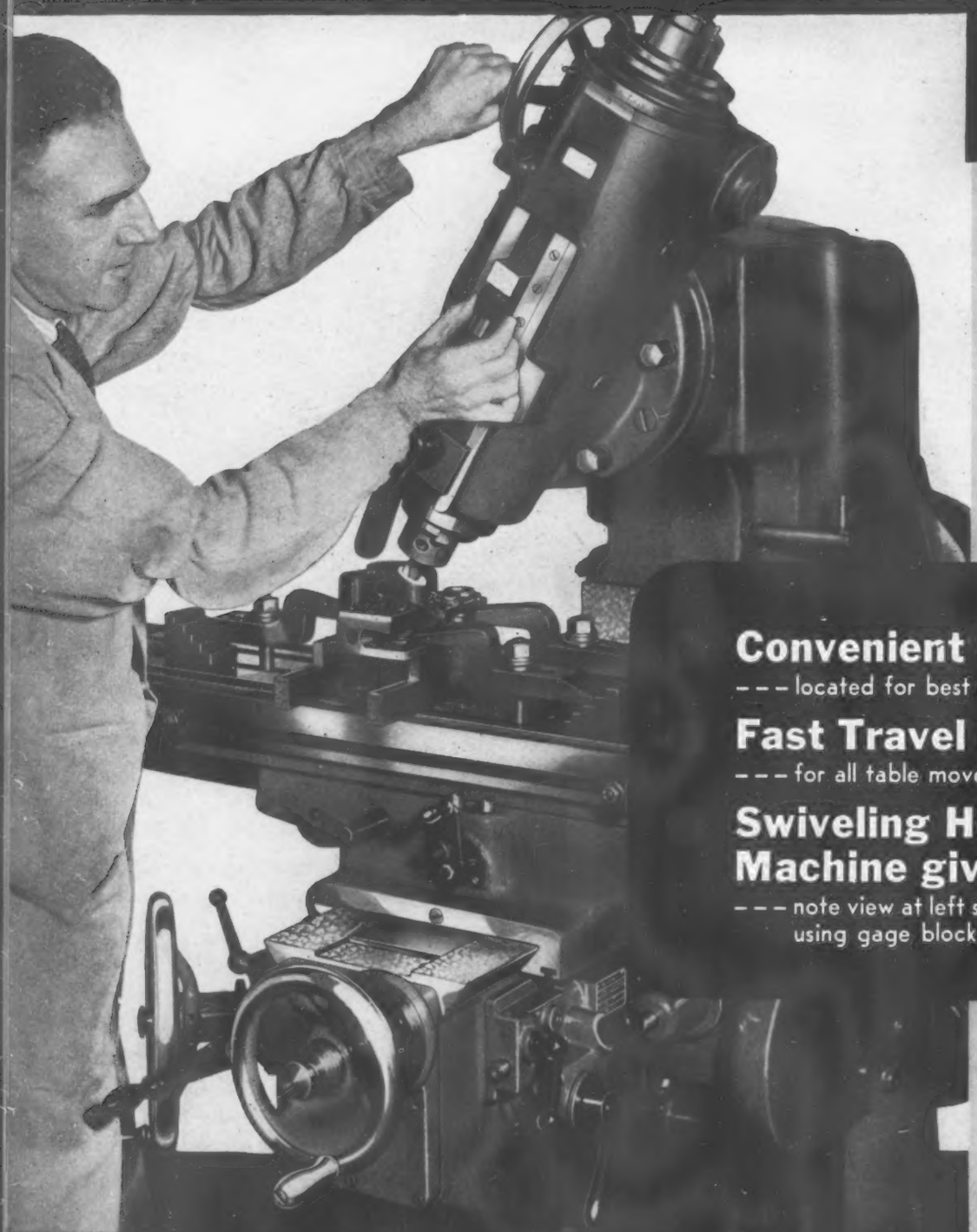
Style RSP Positive Opening Precision Tap with circular chasers. Capacities 2¼ to 5".



NATIONAL ACME

170 EAST 131ST STREET • CLEVELAND, O.

ACME-GRIDLEY 4-6 AND 8 SPINDLE BAR AND CHUCKING AUTOMATICS • SINGLE SPINDLE AUTOMATICS • AUTOMATIC THREADING DIES AND TAPS • SCREW MACHINE PRODUCTS • THE CHRONOLOG • LIMIT SWITCHES • POSITIVE CENTRIFUGE • CONTRACT MANUFACTURING



Convenient Controls
– – – located for best efficiency

Fast Travel Provided
– – – for all table movements

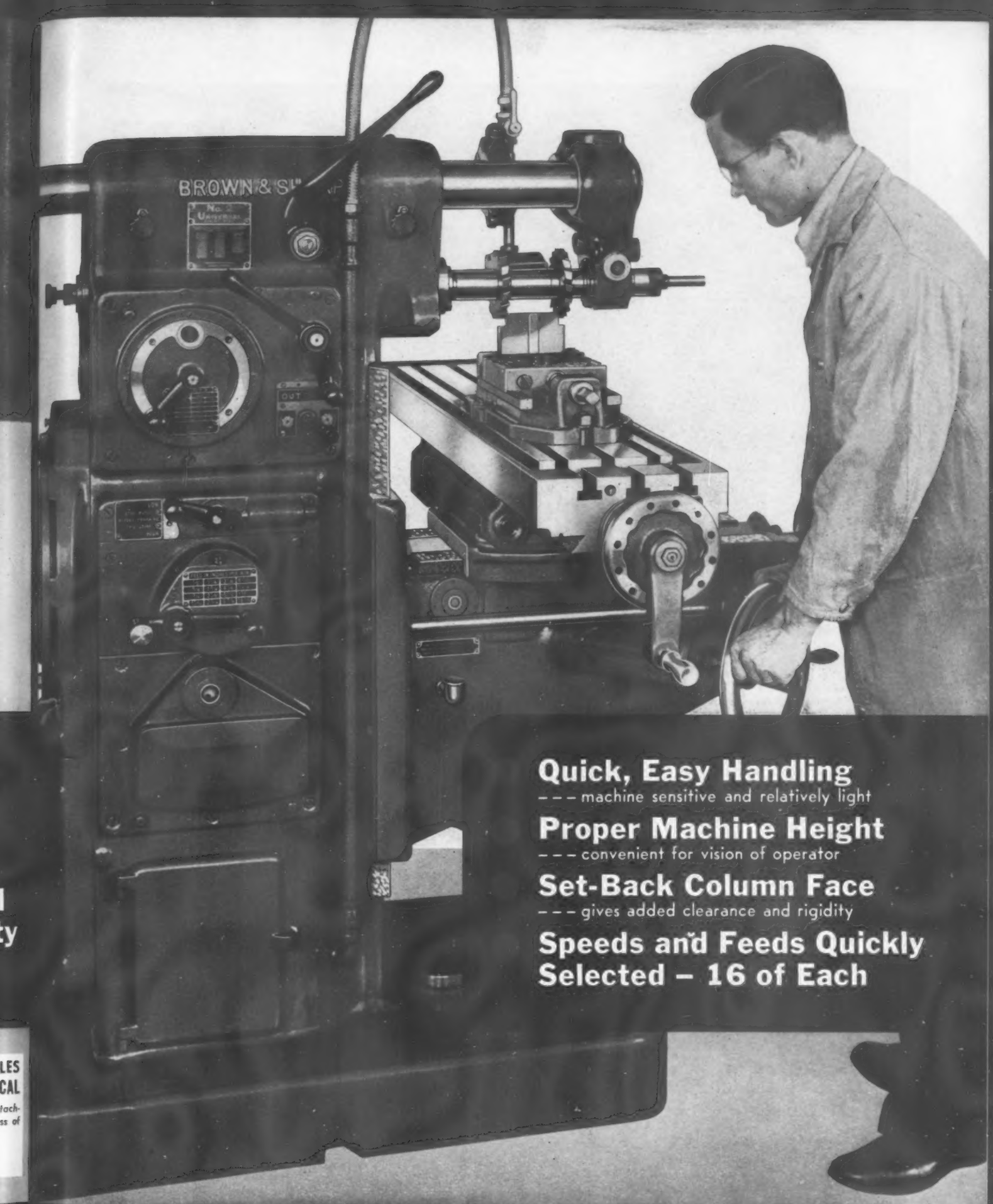
Swiveling Head on Vertical Machine gives Broad Utility
– – – note view at left sinking angular hole, using gage block for accurate duplication

. . . 3 STYLES
UNIVERSAL • PLAIN • VERTICAL

— Ask for specifications *including Attachments* that greatly extend the usefulness of these productive machines

Brown & Sharpe Mfg. Co.
Providence, R. I., U. S. A.

BROWN &



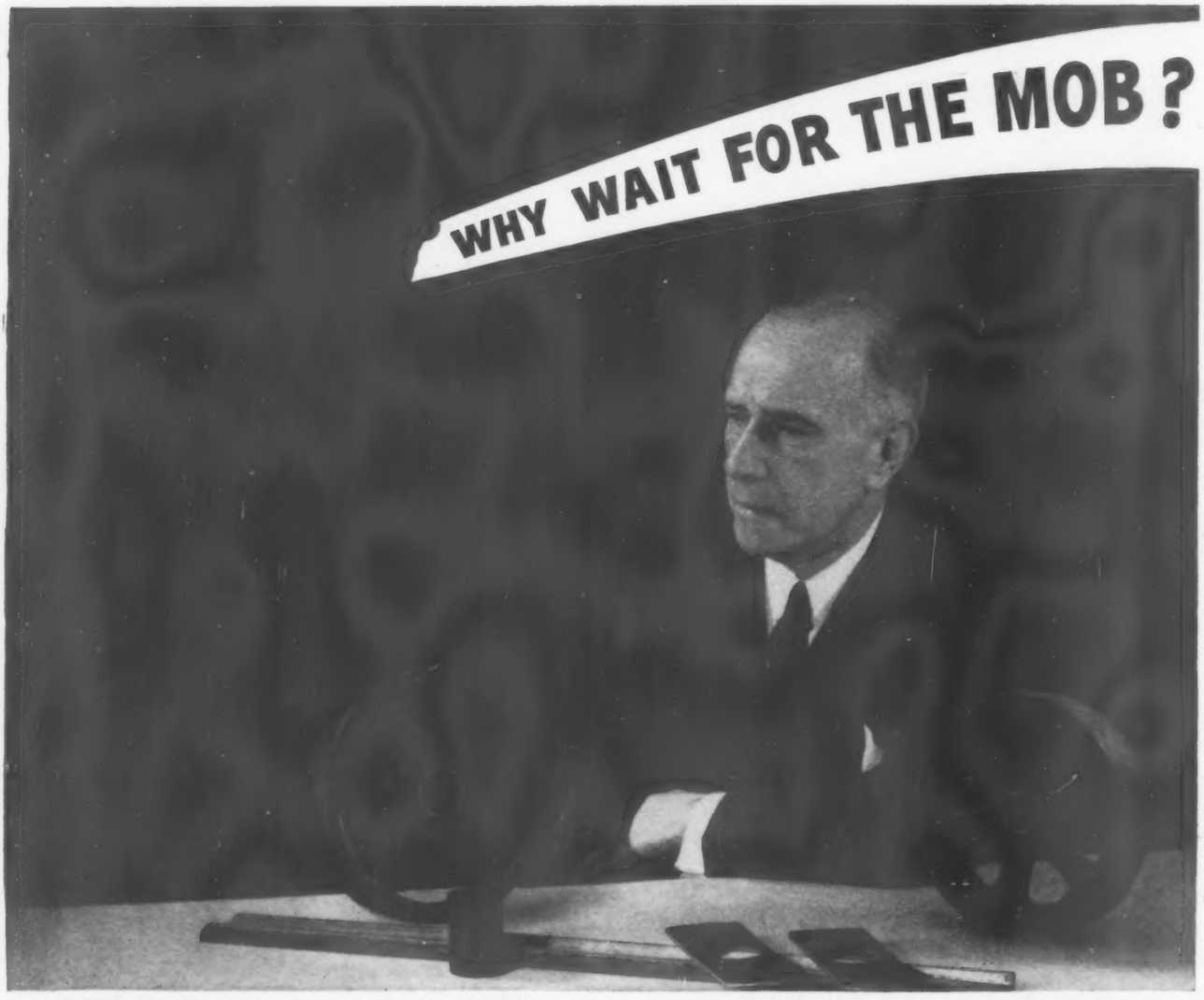
Quick, Easy Handling
– – – machine sensitive and relatively light

Proper Machine Height
– – – convenient for vision of operator

Set-Back Column Face
– – – gives added clearance and rigidity

Speeds and Feeds Quickly Selected – 16 of Each

SHARPE



ALTER EGO: Literally "one's other self"—the still, small voice that questions, inspires and corrects our conscious action.

Welded steel wheel.
Weight—11 lbs.
Cost—42c

Former wheel
Weight—17.5 lbs.
Cost—87.5c

ALTER EGO: So, you're still luke-warm about welding?

Well—some of our competitors use it and some of our customers are asking for it. But—I don't know—Let's make a survey of welding opinion.

ALTER EGO: Oh, so you want the mob to do your thinking? Don't you realize that progress thumbs its nose at the rut-bound crowd?

Well, far be it from me to get rooted in a rut.

ALTER EGO: Look how we got our wheels out of the rut. By thinking in terms of welding—using a piece of channel for the rim—two punched bars for spokes—a piece of pipe for the hub, we've saved 45 cents per wheel, 6.5 lbs. dead weight, and cut out delivery delays. That's Progress!

From now on let's do our own thinking for dozens of other parts like we did for the wheel. One at a time, so as not to hinder production. Let's out-maneuver the mob!

• •

LINCOLN SUGGESTS: *Faith* and *determination* will give you the full benefits of a welding program. Appoint a man with these qualifications and give him authority to get things done *quicker, better,* at *less cost* with arc welding. We *guarantee* your success. Write for "A Guarantee of Profits."

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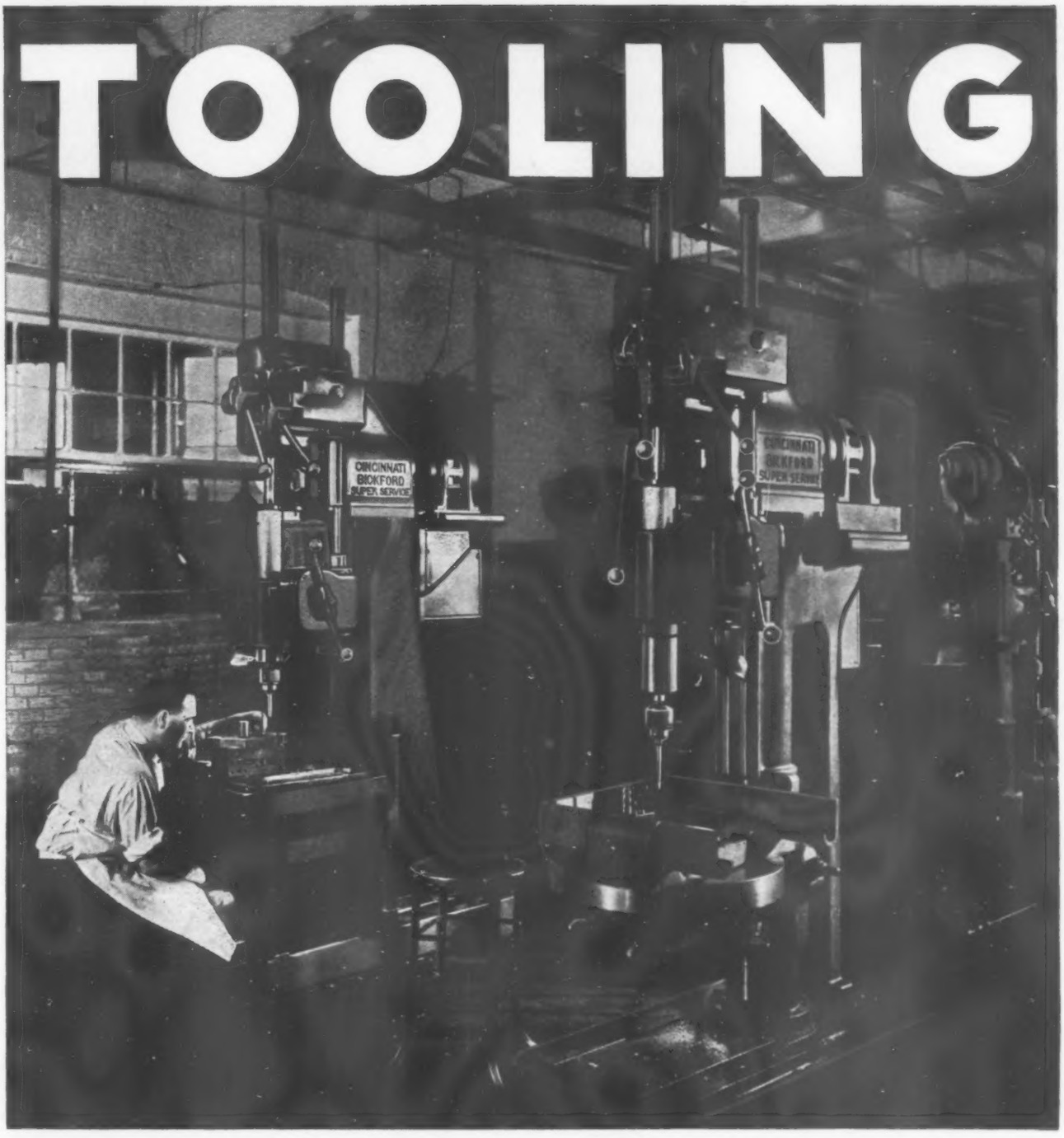
LINCOLN "SHIELD-ARC" WELDING THE LINCOLN ELECTRIC COMPANY Cleveland, Ohio

Authoritative Information on Design • Production • Welding Equipment

TOOLING



These 28" Super Service Upright Metal Drilling Machines, Box and Round Column Types, are located in the Tool Room of The Taft Peirce Mfg. Co., Woonsocket, R. I.

Both types provide wide ranges of spindle speeds and feed rates, enabling them to handle a variety of operations.

Round Column Machines are specially versatile due to the fact that the table on this type machine can be swung out of the way to permit work to be located on the base.

Rigidity and accuracy are assured on the Round Column Machine by virtue of the back brace and on the Box Column Machine because of the table support and heavier column.

These features are vital to manufacturers of precision gages and tools like The Taft Peirce Mfg. Co.

Write for more detailed information concerning the Cincinnati Bickford Super Service Upright Metal Drilling Machines and get Booklet U-25.

THE CINCINNATI BICKFORD TOOL CO.

OAKLEY · CINCINNATI · OHIO · U. S. A.

Are You Up Against PRODUCTION PROBLEMS?

Unprecedented orders and "defense priorities" make immediate deliveries of turret lathes out of the question. Yet, you are probably confronted with urgent demands for greater output.

If you are in this predicament, Warner & Swasey can help you. Do you realize that you may increase your production from 30 to 60% on your present turret lathes with the installation of new Warner & Swasey Turret Lathe Tools? These tools will improve your methods—permit full use of carbide cutters and greatly step up your production. This at least is a partial answer to your problem. Our Engineering Service Department will be glad to study your jobs and make recommendations.

Another way we can help you—make better workmen out of your present operators! We have established a Turret Lathe Operators' Service Bureau to help you train new men. Older operators can benefit, too. All this service is yours for the asking. Write Warner & Swasey, Cleveland, Ohio.

YOU CAN TURN IT BETTER, FASTER, FOR LESS WITH WARNER AND SWASEY TOOLS

Get More Production from Your Present TURRET LATHES!

WHAT'S IN THIS ISSUE

SALUTE

Even the general public at last realizes that in the present crisis American industry is doing its damndest. It knows that every method within reason is being employed to accelerate production. One of the less obvious of these methods is interchange of ideas. Wherever men meet and mingle ideas fly fast and furious, and all comers emerge richer for the experience.

It is just such a contribution that the forthcoming Machine & Tool Progress Exhibition will make to the present defense effort. Never before has the usually leisurely process of tooling up been so vastly accelerated. Never before has so much depended on the outcome. Never before has the tool engineer been more vital to the national security than the soldier, the sailor, the diplomat. For on today's tool engineer rests the responsibility for turning the United States into the Arsenal for Democracy. He may fail. Our opinion is that he'll succeed. In a sincere effort to help him, we take pride in dedicating to him this issue of AMERICAN MACHINIST.

MACHINABILITY'S MEANING

President of the American Society of Tool Engineers is A. H. d'Arcambal, consulting metallurgist of Niles-Bement-Pond's Pratt & Whitney Division. Long an important figure in the A.S.T.E., Mr. d'Arcambal enjoys an enviable reputation in metallurgical circles. On page 211 he has analyzed what, in his opinion, machinability means to defense. His evaluation of the various factors affecting both these controversial topics should be read by all.

CONTINUED

Just to remind you that in this special number we haven't shelved our series on shell machining. Since it deals almost exclusively with tooling, what could be more appropriate? You'll find the fourth installment on page 227.

MATERIAL HELP

Equally appropriate, we think, is the special blue section. This article, which you'll recognize as another of our materials sections, deals with the working of tool and die steel. In it are assembled specifications, recommendations, physical characteristics and properties—probably the most comprehensive collection of data on these steels ever squeezed into sixteen pages. Credit for this section goes to associate editor William J. Hargest, who's been working on the job for months. No clock-watcher is Bill. When on an assignment like this, night and day, Wednesday and Sunday, are all the same to him. Coffee keeps him conscious, makes him the only man we've ever known who can work three shifts a day. The resulting section begins on page 243.

NO?

Devotees of this column know that we've long wanted to write a book. One of the facts of life which always impressed us is that men who are too ignorant to know better are always doing the impossible. Columbus and the Wright brothers weren't the only ones; you undoubtedly can find examples right in your own plant. The whole history of metal-working is a saga of

W. J. BURGER
. . . don't be too sure . . .

doing things that couldn't be done. In case you have the "impossible" attitude toward carbide tools, for instance, we respectfully recommend the article on page 218. By W. J. Burger, Warner & Swasey's director of engineering, Can't Use Carbides? not only poses a few good questions but answers them as well. In the affirmative—or negative, whichever way you look at it.

WHAT'S NEW

New machines, new accessories, new tools—all can be of inestimable value in boosting production. In the Show-in-Print section beginning on page 196 are over fifty such products which can speed many types of metal-working operations. They will all be dispayed at the show, where complete details as to prices and deliveries can be obtained Many will be shown in operation. Whether you're planning to attend the show or not, a serious reading of this section should prove informative.

WHO'S WHO

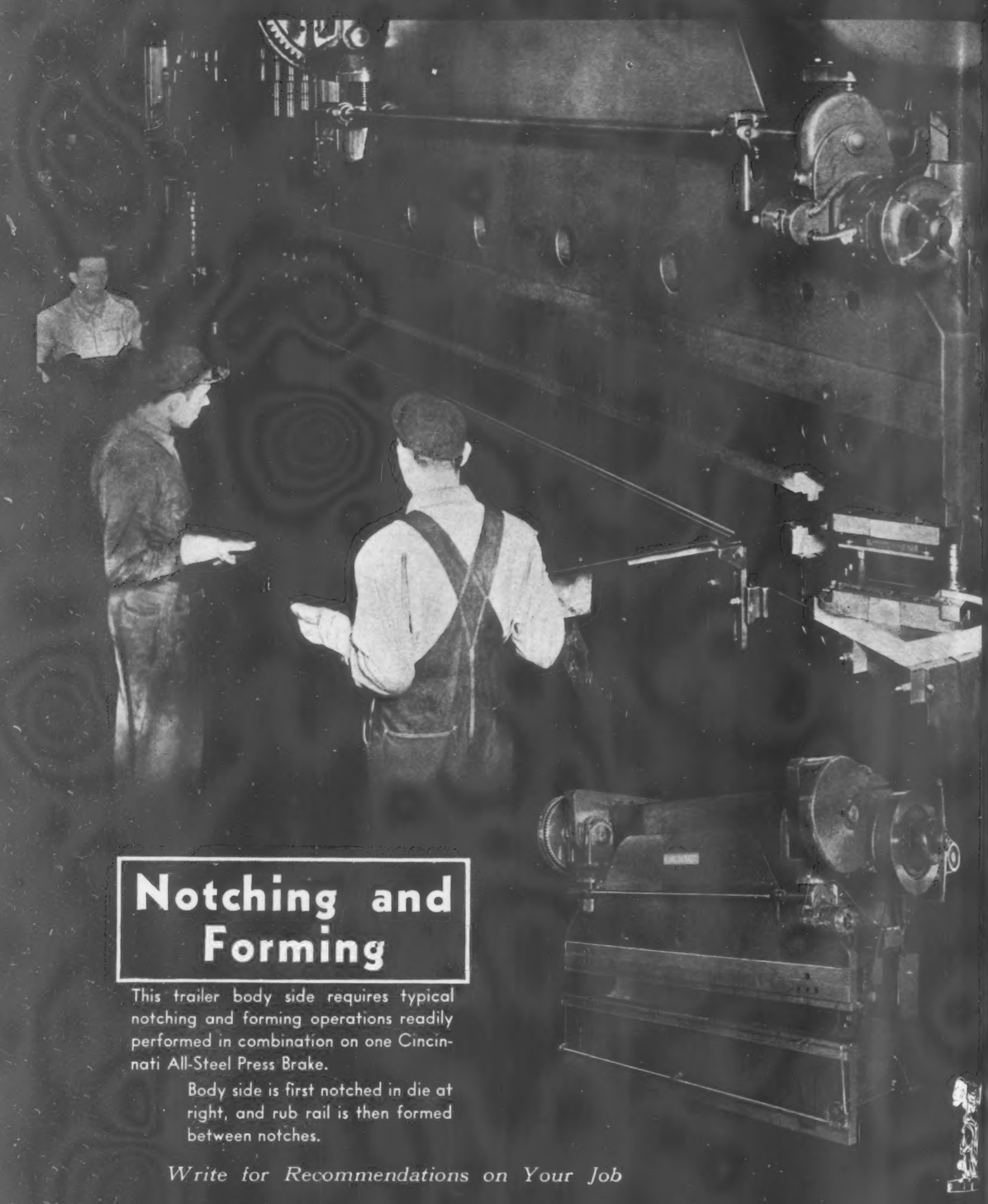
In the Show-in-Print section are described only those products which have been developed recently. Also to be on display at the show are countless other machines and tools which have been on the market for some time and have been previously described in our pages. For your convenience all exhibitors, along with their booth numbers and products they intend to display, are listed on page 209.

LEFT-OVER

The time when toolrooms were assigned space "left over" from production departments happily has faded into history. On the theory that a workman is no better than his tools, and vice versa, wise managements are paying ever increasing attention to toolrooms. Many recognize the toolroom as a miniature plant itself, with problems of efficiency and production all its own. These problems, of course, have a profound effect on individual toolroom layouts, and deserve considerable study. Some of the things to bear in mind, and a few ways of solving stumpers that come up, are given on page 214. In Room for Tools, R. R. Wiese, our western editor, describes in detail some of the more efficient layouts he's run across.

COMING

The next issue will mark the last installment of the shell series—but the tradition will be carried on with plenty more on armament as long as the present production problem persists. Also scheduled for the next number are articles on modern finishing methods, advanced heat-treating techniques, and machine shop instruction in the governmental manner. And a four-part article on hard chrome plating is soon to come. Look for them in AMERICAN MACHINIST!



Notching and Forming

This trailer body side requires typical notching and forming operations readily performed in combination on one Cincinnati All-Steel Press Brake.

Body side is first notched in die at right, and rub rail is then formed between notches.

Write for Recommendations on Your Job

THE CINCINNATI SHAPER CO.

SHAPERS · SHEARS · BRAKES

CINCINNATI, OHIO.

ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

Tool Show

ON THE FIRING LINE

We are well along on America's greatest peacetime effort to provide security for this land of ours. We must have adequate protection in the air, on land and on sea. Our gigantic defense program is designed to provide that protection as quickly as possible. It also is intended to give the maximum aid to Britain.

In that effort the place of the tool engineer is well defined. He is right in the middle of it, up to his neck. New plants must be equipped and tooled for production of unfamiliar products, existing factories must be retooled, the best way of going at the task of making munitions must be determined, and short cuts must be taken to whittle down the time of turning out what is needed.

The problem goes far beyond providing new machine tools and plant equipment. It also consists of getting the most out of what we already have, using the right tools for the right job, getting the highest speeds and the most productive feeds on every operation.

It isn't solely a mechanical problem. The human elements are important, too. Enough skilled machinists, draftsmen, tool engineers and technicians of various kinds must be ready to handle the peak load when it comes later on this year.

In all of these phases of national defense, the tool engineer individually and tool engineers collectively, through the American Society of Tool Engineers, are doing their part admirably. With their sleeves up, they are working long hours and devoting unlimited energy to getting defense production rolling. Through the educational committee of A.S.T.E., they are helping to set up training activities to alleviate the shortage of skilled men.

It is altogether fitting at this time for the A.S.T.E. to present its exhibition at Detroit, March 24 to 29, devoted to better ways and means of doing the defense job. No matter how well we do it, a tremendous task lies ahead. It is unlikely that it could be done in the time specified in any other country than the United States. Our mechanical progress, the high degree of mechanization in American industry, makes it possible for us to do the impossible.

So we turn to the Detroit show and to the technical sessions for further guidance in how to speed up our armament effort. The A.S.T.E. is to be congratulated on its enterprise in staging such a comprehensive program. It is additional evidence that tool engineers as a group are alive to their responsibilities to the nation.

SHOW IN PRINT

New and improved equipment on display at the Machine & Tool Progress Exhibition in Detroit, March 25 to 28

DALZEN THREAD GRINDERS

Tap and gage work in U. S. and Whitworth thread forms, leadscrews, aircraft studs and bolts, and gun components can be ground on the Dalzen thread grinder, to be exhibited in Nos. 1 and 2 sizes. Responsibility for making and selling these machines has been split between Dalzen Tool & Mfg. Co., 511 Leib St., and Snyder Tool & Engineering Co., 3400 E. Lafayette St., Detroit, Mich.

No. 1 machine handles work 3 in. in diameter, 8 in. between centers with a 4-in. thread length anywhere within the maximum work length. Work table pivots 15 deg. either side of center for helix angles. Wheel size is 12x¼x7-in. hole. Floor space needed is 37x47 in. Machine weight is 2,200 lb.

No. 2 machine handles work 6 in. in diameter, 18 in. between centers with a 10-in. thread length anywhere between centers. Wheelhead and column pivot 25 deg. either side of center. Wheel size is 16x¼x7-in. hole. Space needed is 38x60 in. Machine weight is 4,200 lb.

A simplified wheel dresser can be used conveniently in grinding each work piece without causing a loss in production. Dressers can be furnished for standard and special thread forms. Right- or left-hand threads can be ground using the same leadscrew, with the machine cutting on the forward or the backward table feed. Relief can be applied to taps or thread milling cutters by a relieving attachment.

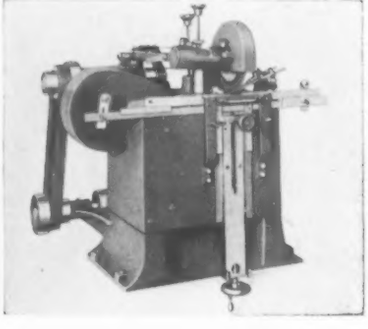
The wheelhead column is adjustable longitudinally for positioning the thread anywhere along the part. Placement of the wheelhead over the work conserves floor space and is said to increase accuracy. Hardened and ground ways run on hardened steel balls.

CONTINENTAL MACHINES "DOALL" SURFACE GRINDER

Continental Machines, Inc., 1301 Washington Ave. S., Minneapolis, Minn., has developed the Model GP "Doall" grinder for utmost precision in surfacing machine parts. Built for either dry or wet grinding, this machine has a table capacity of 9x18 in.

All ways are hand scraped. Spindle, equipped with precision ball bearings, is direct driven by a special dynamically balanced motor. It uses 7½x½-in. wheels. Table movements are hydraulically driven. A built-in dial indicator registering in tenths of thousandths augments hand wheel feed.

Table travel is infinitely variable from 0 to 50 ft. per min. Cross feed is variable from 0 to 150 thousandths at each reversal of table travel. Automatic cross feed movement is provided for wheel dressing. A built-in fluorescent lamp provides cool illumination. Automatic lubrication is provided. Coolant systems are standard.



WARDWELL COMBINATION AUTOMATIC GRINDER

Wardwell Mfg. Co., 3167 Fulton Road, Cleveland, Ohio, has introduced the Model E-C combination automatic saw grinder for sharpening circular, hack and band saws in a wide range of sizes. It is claimed that saws reclaimed in this grinder will operate more efficiently than new ones.

When a blade is reclaimed the teeth have sharp cutting edges, at a 90-deg. angle with the blade. It is this slight alteration over the form and angle produced in the original blade by setting the teeth over which is claimed to result in more efficient cutting. It is claimed that the method of grinding will not burn, anneal or in any way injure the hardness of the teeth.

BOICE-CRANE "HI-SPEED" BANDSAW

Features to promote greater accuracy and higher production are incorporated in the No. 2300 14-in. "Hi-Speed" metal cutting bandsaw offered by Boice-Crane Co., 1730 Norwood Ave., Toledo, Ohio. Light-weight plastic wheels and extremely rigid welded frames contribute to exceptionally smooth operation.

Single-speed, 1200 r.p.m. models with direct connected motors in both bench and floor types, are available, as are V-belt drive bench models. A fourth model, developed especially for the metal-working industry, is equipped with a selective speed gear box providing eight speeds from 25 to 1120 r.p.m.

Specifications: wheel diameter, 14 in.; maximum depth of cut, 8⅝ in.; throat depth, 13½ in.; tilting worktable, 15x15½ in. Weight is 322 lb.

OHIO CRANKSHAFT "TOCCO JR." INDUCTION HARDENER

Ohio Crankshaft Co., 6600 Clement Ave., Cleveland, Ohio, will display the 20-kw. "Tocco Jr.," induction hardening machine, specially designed for heat-treating small parts. This machine comes in two models: one for applications not requiring quenching, such as annealing, brazing, soldering, heating for forming, and forging; the other for localized hardening. The basic machine has a flat top on which may be mounted any desired fixtures.

For localized surface hardening, a transformer housing is added to top of unit and a work pan set in. The inductor block is bolted to the attachment flange. Included in the transformer housing are the quench and cooling water valves. Condensers are below. Both units use the same high-frequency motor-generator sets, supplying 9600 cycles at 220 volts.

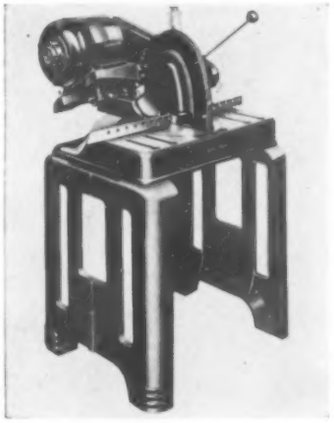
GROB COMBINATION SAWING-FILING MACHINE

Model No. NS-24 combination band sawing and chain filing machine offered by Grob Bros., Grafton, Wis., provides a throat of 24 in. by the use of two 24½-in. diameter pulleys.

Pulleys have inlaid rubber bands for operation of the saw blade, while alongside the rubber band a groove is provided for operation of the file chain. The lower drive pulley has provision for a positive drive to the file chain so that little tension is required.

By tracking the saw blade and the file chain alongside each other, that is, each separately, a change from sawing to filing or vice versa is made in less than a minute since saw guides and file attachments can be left in the machine at all times. A Type BW butt welder quickly welds saw blades for internal cutting.

The lower pulley is driven by a 1-hp. motor by a V-belt reduction drive providing 10 speeds from 50 to 2000 ft. per min. Base and column are welded steel. The 24x28-in. cast iron table tilts in two planes. Table feed is operated by a foot lever.



DELTA CUT-OFF MACHINE

All non-ferrous metals can be cut quickly and smoothly with this cut-off machine developed by Delta Mfg. Co., 600–634 E. Vienna Ave., Milwaukee, Wis. With this machine material can be cut at any angle.

Arbor is accurately ground and rides in sealed ball bearings. A universal clamp is designed to hold securely all shapes and sizes of material. Special blades assure maximum efficiency on all types of materials. When using these blades, this machine will cut brass up to 1½ in. in diameter, aluminum up to 1¼ in. in diameter, aluminum extruded sections up to the equivalent of 2 sq. in., copper up to 1½ in. in diameter and magnesium up to 1¼ in. in diameter. Tubular sections up to 2 in. in diameter can also be cut.

GROB LIGHT-DUTY FILING MACHINE

Many features of larger machines are incorporated in the No. FB-18 light-duty filing and lapping machine offered by Grob Bros., Grafton, Wis. This machine has an 18 in. throat and is said to be capable of production to within an accuracy of 0.001 to 0.002 in.

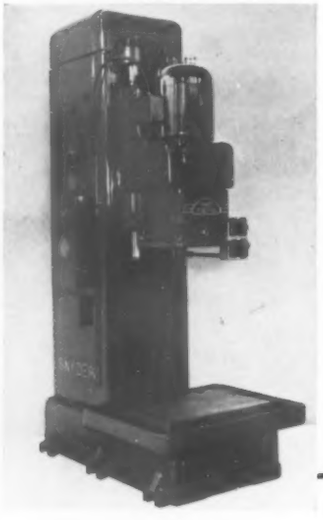
The machine is claimed to be capable of quick set-up and frequent set-up changes. It can be easily set up for internal cutting, as file tension is removed by turning a single lever. It is said that various types of files and lapping stones can be installed in less than a minute.

DELTA CARBIDE TOOL GRINDER

Delta Mfg. Co., 600–634 E. Vienna Ave., Milwaukee, Wis., has developed a carbide tool grinder especially for the small tool room which requires an inexpensive precision machine. It is available either as a bench or as a pedestal model, with several types of single and three-phase motors.

Speed of 3,450 r.p.m. gives a surface speed of both wheels of 5,200 ft. per min. Accurately ground tables are 13½ in. wide and 8 in. deep. They tilt 30 deg. toward the wheel and 45 deg. away from the wheel. They have grooves for jigs and fixtures. A reversing switch is built into the machine for greater convenience in grinding both right- and left-hand tools.

SNYDER PRODUCTION DRILLING MACHINES



Two upright drilling machines intended for production work, primarily requiring multiple-spindle heads, will be exhibited by Snyder Tool & Engineering Co., 3400 E. Lafayette St., Detroit, Mich. Of exceptionally heavy construction, these machines feature automatic hydraulic feed cycle, hydraulic pump and motor within the column, and head movement controlled by adjustable dogs.

In these machines the head does not slide in ways. Instead, the head is bolted to a platen which moves on two round steel guide bars. Hardened bushings in the platen minimize wear.

Spindle drive is through transmission box and pick-off gears in the head. Single-spindle machines are supplied with a two-speed transmission.

No. 10V18 machine is supplied with either a 10- or 15-hp. motor. Maximum clearance between head and table is 56 in., minimum 38 in. Drilling capacity of single-spindle machine is 4 in. diameter in cast iron or mild steel. Machine will also handle ten 1-in. drills in cast iron at 90 ft. per min. Box table measures 31½x29¼ in. Floor space, 36½x60 in. A 2-hp. motor drives the hydraulic pump. Cycle involves advance at 225 in. per min., feed variable between 1 to 6 in. per min., and rapid return.

For No. 20V16 machine either a 20- or 25-hp. motor is supplied. In the single-spindle type, drilling capacity is 5 in. For multiple-spindle drilling, ten 1¼-in. drills can be operated in cast iron at 90 ft. per min. Maximum clearance between head flange and box table is 56 in., minimum 40 in.

LE MAIRE VERTICAL CONTOUR MILLER

Le Maire Tool & Mfg. Co., 2657 S. Telegraph Road, Dearborn, Mich., will display the "Multa-Miller" vertical contour milling machine. This machine is equipped with V-belt drive, 6-spline alloy steel spindle on preloaded anti-friction bearings, longitudinal and cross-wise slides with hydraulic movement, and indexing or stationary circular table optional. Contour control is obtained by twin contour cams and rollers producing the necessary parallel cross-slide motion.

Feed rate of the longitudinal slide can be varied from 0 to 12 in. per min. with 118 in. per min. rapid advance and 128 in. per min. rapid return. Maximum cutter movement with stationary circular table is 2 in. crosswise and 5 in. longitudinally. With indexing circular table the maximum cutter movement is 1¾ in. crosswise and 3 in. longitudinally. The machines requires a space of 28x60 in.

ATLAS MULTIPLE-SPINDLE DRILLING MACHINE

Atlas Press Co., Kalamazoo, Mich., has introduced a line of multiple spindle drilling machines which are built with two, three or four spindles. Drilling heads are ball bearing equipped, with a new crank type of head raising mechanism. Machines are particularly recommended for all types of small hole drilling and tapping.

Specifications: maximum distance, table to chucks, 26 in.; columns to center of spindles, 7½ in.; spindle travel, 4 in.; over-all height, 79½ in.; over-all depth with motors, 31¼ in. Available with 0-½ in. Jacobs chuck or No. 1 Morse taper spindles in place of chucks. Motors recommended 1/3 or ½ hp. at 1740 rpm. (Ball bearing).

AMERICAN BROACH HYDRAULIC GUN RIFLING MACHINE

This hydraulic gun rifling machine built by American Broach & Machine Co., Div. of Sundstrand Machine Tool Co., Ann Arbor, Mich., broaches rifling grooves of constant helix in gun barrels. It pushes a high-speed steel cutter through the gun, driving the cutter in the proper helix angle to broach all grooves together. Each cutter has a slightly increased diameter over the preceding one so as to take chips approximately 0.001 to 0.002 in. thick.

The machine consists of a fabricated steel bed containing the hydraulic cylinder, oil reservoir, valving, piping, motor, motor controls, and coolant system. Slide is of normalized and seasoned nickel iron. The cylinder is of steel tubing; bored and honed to a mirror finish. Ways are accurately scraped to a full bearing and guided in the hardened and ground bed ways which are automatically lubricated.

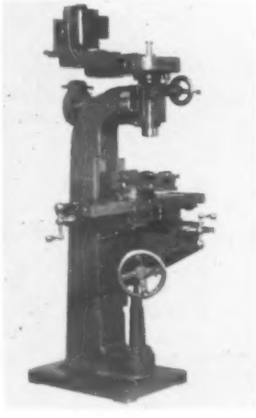
The master lead bar is hollow to permit a generous supply of coolant at the cutting tool. This lead bar is driven laterally through a roller thrust bearing by the cylinder slide unit, and spiraled by a driving plate, adjustable for index. The driving plate unit is provided with a backlash take-up adjustment. The quill carrying the cutters is mounted by a taper shank in the end of the master lead bar. This machine is driven by a Sundstrand variable delivery pump, direct from the 15-hp. driving motor.

The part is located at the muzzle end by an integral manually operated clamp and support block. It is also located at the breech end by a similar manually operated lock station, mounted on the machine bed. End thrust during cutting is taken by the tailstock mounted on the left end of the machine bed. Work is clamped between soft split bushings.

Specifications: capacity, 12 tons; cutting speed, 15 ft. per min.; return speed, 30 ft. per min.; maximum stroke, 100 in.; weight, 24,000 lb.

LOGAN ENGINE LATHE

On display at the booth of the Logan Engineering Co., 4912 Lawrence Ave., Chicago, Ill., will be a new back-geared metal-cutting lathe of 10 in. swing with 24 in. between centers. This lathe has a precision preloaded ball bearing headstock, power longitudinal and cross feeds, prismatic V and flat ways, and is equipped with a unit countershaft assembly. With this standardized, general-purpose machine threads from 4 to 216 per in. can be cut.



BLANK & BUXTON VERTICAL MILL

A feature of the exhibit of Blank & Buxton Machinery Co., Jackson, Mich., will be the No. 40-H index high-speed vertical mill, which has been especially designed for the tool, die and experimental shop for milling, boring and drilling.

This machine has a capacity of ⅛ to ⅝ in. end mills in tool steel, and has six standard spindle speeds ranging from 180 to 2400 r.p.m. with single-speed motor. Special two-speed motor is also supplied. It is equipped with longitudinal and cross verniers for locating milling and boring positions. Spindle travel is 3¼ in. Maximum distance from the end of the spindle to the table is 16 in., while the minimum distance is 0 in.

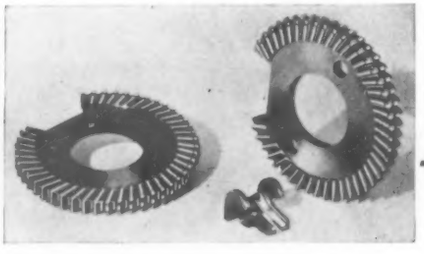
SCHERR "COMPARITOL" MEASURING INSTRUMENT

Featured in the exhibit of George Scherr Co., 128 Lafayette St., New York, N. Y., will be the "Comparitol" precision measuring instrument which works on a new patented knife-edge principle. This instrument may be used to inspect and check mass-produced parts for interchangeable manufacture, shop gages and other precision parts. Personal errors are eliminated.

The mechanism consists of only two moving parts—a vertical spindle which carries a contact feeler point and a horizontal beam carrying the indicating hand. A stationary knife edge supports the horizontal beam while a second knife edge contacts the horizontal beam on the upper side. Construction is rugged to enable the instrument to withstand daily shop use.

"RED RING" CIRCULAR BROACH

National Broach & Machine Co., 5600 St. Jean St., Detroit, Mich., has developed "Red Ring" circular broaches for cutting circular T-slots in a single revolution and at a production rate of approximately 100 per hour. These tools, used in a Krueger circular broaching machine, are claimed to make possible both higher speeds and greater accuracy than can be obtained with either milling or boring, and at less cost.



The slot in the part shown is done with a broaching tool which has a 54-deg. gap into which the work is inserted in order to start cutting. The fixture which holds the work is mounted on two slides, one of these being movable for depth and the other used to position the work relative to the center of the cutter. After the parts are clamped, a push on the start button causes a hydraulic circuit to advance the fixture against the stop. The cutters then rotate through a complete revolution and the fixture is backed away. The cycle is completely automatic. Action of the cutter is such that it progressively cuts first the sides of the narrow part of the T, then a groove in the bottom of the T, and finally the under-cut portion to form the sides of the T.

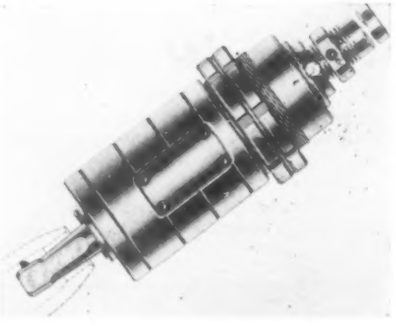
SCHERR "INSPECTOSET" GAGE BLOCKS

"Ultra-Chex Inspectoset" gage blocks have been developed by George Scherr Co., 128 Lafayette St., New York, N. Y. This set consists of 34 length standards and will produce all combinations in steps of 0.0001 in. from 0.3 to 8 in.

GAIRING SPECIAL SHELL BORING TOOL

Gairing Tool Co., 21221 Hoover Road, Detroit, Mich., has developed a boring tool which automatically expands while a cut is being taken on the inside of the shell nose to machine the radii to the end of the bottleneck. This cutting tool is fed radially outward as it moves into the shell cavity to suit the changing contour of the shell interior on 3.45 in. shell. It automatically retracts from the cutting position.

The operation is performed after the fuse hole is bored, the end faced to length and to a conical seat and after the nose end of the shell has been chamfered.



STERLING "GYRO" ELECTRIC SANDER

Hand-sanding in connection with all types of final finish work is eliminated with the "Gyro" portable electric sander developed by Sterling Tool Products Co., 363 E. Ohio St., Chicago, Ill. This sander has a self-contained, gear-driven electric motor and can be plugged into any socket. The flexible sanding pad operates in a movement which closely simulates hand-sanding.

Operating at 4,000 r.p.m., it is reported to do a sanding job in a fraction of the time required by hand. Abrasive paper is easily attached to the sanding pad and held in place by a special holder. It uses one-quarter of a 9x11-in. sheet. It can also be used for rubbing and polishing, in which case cloths can be attached in like manner.

Sander is sturdily constructed for continuous service, yet weighs but 3½ lb. Only one hand is needed to guide it.

BARBER-COLMAN INTERLOCKING SLOTTING CUTTER

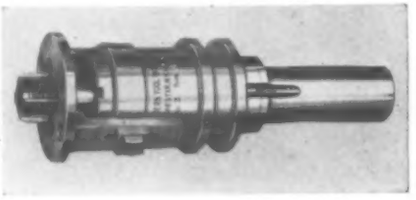
Barber-Colman Co., Rockford, Ill., has developed an interlocking slotting cutter of new design which is used to slot forged steel shifter forks for tractors. In this operation, a cutter 8 in. in diameter cutting a slot 2 3/32 in. long, 1 1/4 in. wide and 1 7/32 in. deep is fed at 2.36 in. per min. and run at a speed of 31 r.p.m. With this set-up approximately 13 pieces continuously are milled per hour.

Instead of having a herringbone type tooth construction, this cutter has teeth arranged so that they slant alternately one way and then the other. This is claimed to eliminate any chance for the teeth to load up in the center, and to enable it to produce approximately 50 per cent more parts for each sharpening.

"MODERN" COLLAPSING TAP

Modern Tool Works, Div. of Consolidated Machine Tool Corp., Rochester, N. Y., will display a line of stationary and rotary collapsible taps for use on turret lathes, hand screw machines and drill presses. These taps are constructed with all parts made of steel hardened and accurately ground. Body is made in one piece with a solid end. Regular chasers extend beyond face of tap body, permitting close to bottom tapping. The tap body is also designed with generous chip clearances.

Chasers, which are set in on an angle, are easily removed, as it is necessary to remove but one screw at end of body. Provision is made for adjustment of large and small threads by means of conveniently located setscrews. Collapsing is positive and always at the same point. The hardened steel trip plate is set for depth of threaded hole desired, and when it comes in contact with the work the tap is automatically collapsed. Trip plate can be easily adjusted to any desired thread length. The stationary type is fitted with a handle for resetting the tap, while the rotary type has a sleeve for resetting. In this way one tap can be easily converted for use as the other. Both types are available in twelve sizes from 1/16 to 3 1/4 in. diameter, with each size having a wide threading range.



STANDARD GAGE MIDGET INDICATOR

Standard Gage Co., Poughkeepsie, N. Y., offers a universal midget indicator which is claimed to differ principally from other small indicators in that it contains a completely geared and fully jeweled transmission, without any cam or lever action. The measuring spindle moves in a straight line.

This indicator measures to within 0.0001 in. Dial graduations are 1/10 in. apart. Coarser graduations are also available.

Length of the instrument is 2 3/8 in.; overall width is 1 1/4 in.; dial diameter is 1 in. Weight is 2 oz. Several types of holding accessories are available.

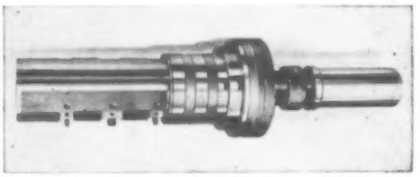
BARBER-COLMAN INSERTED BLADE REAMER

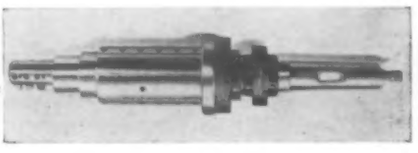
On display at the booth of Barber-Colman Co., Rockford, Ill., will be a line of inserted blade reamers and samples of the work which these reamers produce. With these reamers, which are equipped with Carboloy tipped blades, the center hole of aluminum washing machine gyrators is reamed at a spindle speed of 350 r.p.m., with the reamer fed by hand. Production is 40 pieces per hour complete, with 50,000 pieces for each sharpening.

SCULLY-JONES SPECIAL TOOLS

Scully-Jones & Co., 1901 S. Rockwell St., Chicago, Ill., has developed a line of special tools for recessing, grooving, undercutting, necking and facing.

In operation a ball bearing stop collar strikes against the work or bushing, stopping the forward movement, while the rear portion of the tool continues in motion, feeding the toolbit into the work. Adjustment is provided for the toolbit after regrinding, for location of groove, for correct depth setting in controlling the diameter of recess, and for length of recess or groove in tools where the bit moves forward after reaching the maximum diameter of its cut. Holes as small as 1/8 in. can be recessed with grooves of varying width and depths.





STANDARD DIAL SNAP GAGE

Tolerances of the order of 0.0001 in. are claimed to be maintained through use of dial snap gages developed by Standard Gage Co., Poughkeepsie, N. Y. Pressure applied is constant and measurements are said to be invariably repeated.

A newly designed indicator, graduated in 0.0001 or 0.001 in. or 0.01 or 0.005 mm. is built into the frame. The dial is convenient to read while the gage is in operation, as it is in the direct line of vision above the operator's hand. In turning and cylindrical grinding, the gage enables the operator to determine when the piece approaches the plus limit and to control the feed accordingly, thus preventing rejection.

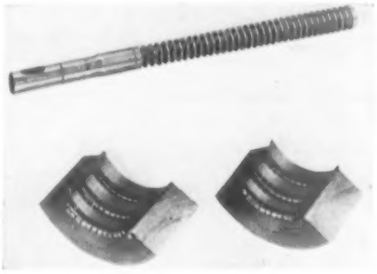
Internal mechanism is shockproof, so that the indicator is protected against excessive impacts. Gaging faces are tipped with tungsten carbide, beveled on the front edge. Zero setting is effected with gage blocks or cylindrical masters, and locked by the AGD standard lock.

Each gage has a $\frac{9}{16}$-in. range. Eight sizes cover all dimensions up to $4\frac{1}{16}$ in. Ranges overlap $\frac{1}{16}$ in.

NATIONAL DOUBLE JUMP BROACH

National Broach & Machine Co., 11457 Shoemaker St., Detroit, Mich., has developed the "Red Ring" double jump broach for cored and pierced holes in castings and forgings which require relatively heavy cuts to keep the cutting edges of the broaches below the hard surface scale. Getting under this scale materially increases broach efficiency and reduces tool maintenance.

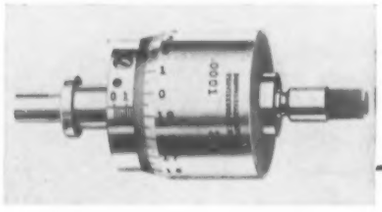
To accomplish this the teeth of the broach, except those in the straight section, are arranged in pairs. Both teeth in a pair have the same diameter, but the forward one is splined while the rear is solid. Spline width is equal to spline space, so that as the tooth passes through the hole it removes half the material around its circumference. The solid tooth following removes the rest. Thus each tooth takes only half the cutting load. Normal tooth diameter increase from one pair to the next is 0.030 in. The sizing teeth are all the same diameter, but to provide proper finish prior to sizing, several teeth just ahead of the sizing section are stepped up gradually in diameter. This broaching method has avoided use of roughing and finishing broaches on certain operations in automotive and tractor industries.



SUPER TOOL GRINDING ATTACHMENT

An attachment for the accurate grinding of squares, hexagons and radial relief will be displayed by Super Tool Co., 21650 Hoover Road, Detroit, Mich. This attachment is said to be readily adjustable to required diameters, and to incorporate flexibility which permits its use on a wide variety of work. With it any number of equal flat surfaces can be accurately produced, while relief grinding is adjustable to meet virtually any requirements.

BROWN & SHARPE MICROMETER HEAD



Brown & Sharpe Mfg. Co., Providence, R. I., has added the No. 293RS $\frac{1}{2}$-in. micrometer head to its line of precision tools. The measuring screw, English measure, has 50 threads per inch and the thimble has 200 graduations which read directly to 0.0001 in. The measuring screw, metric measure, is of $\frac{1}{2}$ mm. pitch so that the 200 graduations on the thimble read direct to 25 ten-thousandths of a millimeter.

Length of shank is approximately $3\frac{1}{4}$ in., and is threaded back $\frac{1}{8}$ in. from the end for a lock nut. Diameter of the shank is $\frac{3}{8}$ in. Spindle projects $\frac{9}{16}$ in. with the micrometer set at zero.

"SJOGREN" SPEED COLLET CHUCK

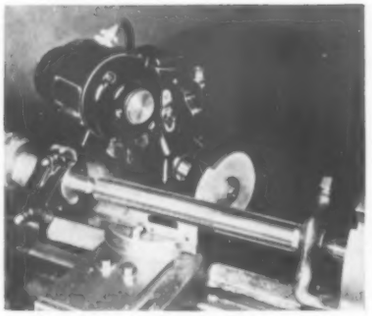
Capacity is increased and time saved with the "Sjogren" speed collet chuck offered by Hardinge Bros., Inc., Elmira, N. Y. This device, which eliminates keys and wrenches, saves considerable time since a slight turn of the handwheel one way or the other opens and closes the collet.

The device is fitted to the lathe in the same manner as an ordinary three- or four-jaw chuck. Capacities from 1 to $1\frac{3}{4}$-in. round are available.

DUMORE THREAD GRINDING ATTACHMENT

A reversible portable precision grinder and accurate thread grinder are combined in an attachment for the No. 5 precision grinder built by the Dumore Co., Fourteenth & Racine Sts., Racine, Wis. This device is claimed to be particularly suitable for small lot thread grinding jobs.

As delivered, the device includes a steel carrying case, mounting post for the No. 5 grinder, wheel dressing attachment, set of fine and coarse grinding wheels, wheel guard and a steady-rest for dressing attachment. The regular unit is built for grinding U. S. or standard threads.



MIDWEST HARDENED TOOL SLEEVES

Midwest Tool & Mfg. Co., 2360 W. Jefferson St., Detroit, Mich., has developed a line of hardened and ground sleeves which are claimed to give from ten to twenty times the life of ordinary soft steel sleeves. The hardened surfaces of these sleeves are said to maintain perfect tool alignment and reduce production rejections to an absolute minimum. These sleeves, which are carried in stock, are made in 101 sizes of both Morse and Brown & Sharpe tapers.

"MAGIC" CHUCKS AND COLLETS

Modern Tool Works, Rochester, N. Y., is offering "Magic" quick-change chuck and collet equipment to reduce the idle time of revolving spindles to practically zero. With this chuck in revolving-spindle machines, tools can be changed while the machine is running without even slowing down the spindle.

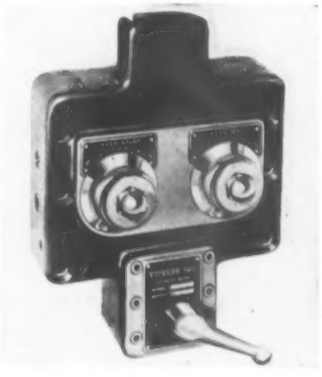
These chucks take all spindle tools. Various sequences of operation can be performed continuously as tools are quickly changed. Simple, durable construction assures long, trouble-free life. Both positive drive and friction drive types are available. They are made in six capacities from $1\frac{3}{8}$ to 5 in. diameter.

JOHNSON "HI-SPEED" HEAT-TREATING FURNACES

Displayed by Johnson Gas Appliance Co., 520 East Ave., Cedar Rapids, Iowa, will be a line of "Hi-Speed" heat-treating furnaces in operation. Included will be the No. 130, shown at the right, which produces a temperature of 2300 F. in 22 min. Another furnace, the No. 570 pot-hardening and metal melting furnace, not illustrated, will also be exhibited.

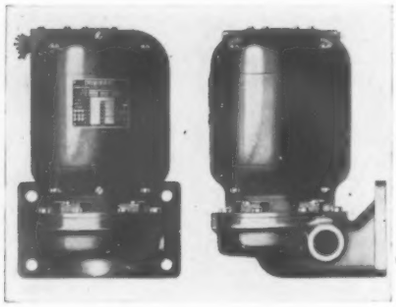
Advanced engineering principles are said to have resulted in these furnaces reaching maximum temperatures in extremely short time, with a gas consumption which is a marked reduction over ordinary types.

VICKERS TRAVERSE AND FEED CONTROL



Operating cycles for machine tool tables or heads which require rapid advance and feed in both directions of motion are provided in a hydraulic control panel developed by Vickers, Inc., 1400 Oakman Blvd., Detroit, Mich. The cycle can be reversed manually by means of the operating lever, mechanically by pilot pressure, or electrically by integral solenoids.

Operating lever provides a convenient manual control at all times for setting up and adjusting. Feed rates in opposite directions are independently adjustable by the dials on the panel. Length of working stroke is adjustable by control cams in the T-slot at the side of the table or head. A great variety of two-directional traverse and feed cycles can be obtained with this single compact control panel unit by various combinations of cams, different electrical hook-ups and the use of suitable contacts. The panel may be mounted in any position on the machine and upon either a stationary or moving element.



PIONEER COOLANT PUMPS

Pioneer Engineering & Mfg. Co., 31 Melbourne Ave., Detroit, Mich., has developed a Model VBA coolant pump for extreme compactness, so that it can be located in positions impractical with other types.

This pump is claimed to be capable of functioning efficiently with an extremely low liquid level, particularly in shallow places. Positive prime is assured even with reduced height of coolant in the supply tank. The device can be readily taken apart and serviced. Motors have been modernized by streamlining.

WESTINGHOUSE VARIABLE SPEED A.C. DRIVE

Westinghouse Electric & Mfg. Co. East Pittsburgh, Pa., has devised a simplified a.c. variable speed drive, suitable for a 10:1 speed range, which is especially adaptable to machine tools.

No exciter or control wiring is required in this drive, which consists of a standard squirrel-cage induction motor driving a d.c. series-wound generator. The generator furnishes power to a d.c. motor which drives the external load, the speed being controlled by a shunting rheostat which varies the generator series field.

These drives should find a wide field of application in metal-working and other industries, for conveyors, machine tools, or similar equipment requiring wide speed range where alternating current only is available. Capacities range from 1 to 15 hp.

MICROMATIC HONE "MICR-O-SIZE" CONTROL UNIT

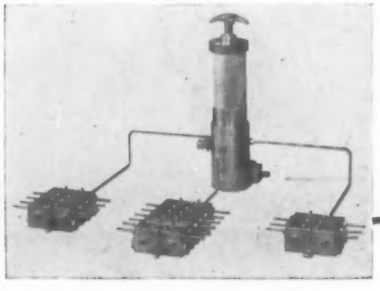
Developed by Micromatic Hone Corp., 1345 East Milwaukee Ave., Detroit, Mich., the "Micr-O-Size" automatic control unit is said to generate accurate sizing, with high production, within limits from 0.002 to 0.005 in., reducing the tolerance range and number of selective fits. Where included in the combined results produced by honing, it offers increased production through simplified practice.

Mechanism is arranged with visual dials to facilitate set-up, adjustment, and complete operating control. Additional controls provide for instantaneous abrasive expansion only to average rough bore size by hydraulic pressure control, and thereafter positively restrained against any backlash, followed by a controlled, uniform rate of abrasive expansion feed-out to uniform size and finish, under variable pressure, hydraulically actuated control synchronized with an adjustable time cycle, and collapse of the abrasive members to the same starting diameter under mechanical control and with automatic compensation for average stone wear.

A typical application is: In automotive engine pistons, from 0.0005 to 0.001 in. stock is removed from 0.750-in. diam. 13/16-in. long piston pin holes in one operation, following precision boring, in a honing cycle of 15 sec. Accuracy for roundness and straightness is generated to within limits of 0.0002 in. Final surface finish is from 3 to 5 microinches.

TRABON DISTRIBUTOR SYSTEM OF LUBRICATION

Trabon Engineering Corp., 1814 E. 40th St., Cleveland, Ohio, has developed a distributor system of lubrication equipment, particularly adaptable for machine tools, by means of which various amounts of lubricants can be supplied to different points. The unit handles either oil or grease and employs a positive feature by means of which lubricants must be delivered from every outlet or the operator receives immediate warning of the danger.



Shown is a pump with three outlets, each of which is connected to distributors. Tubes leading from distributors represent lines that would be connected with the bearings. In the illustration one group is provided with eight outlets, another twelve, and the third six; however, the number of outlets may be varied to suit the requirements of the particular machine.

The sections of the distributors discharge various amounts of lubricant, and assemblies may be made to give almost any combination of discharge quantities desired. The distributor will deliver lubricant progressively from one outlet to another until the cycle is completed and all connected bearings have been served. They may be installed not only to receive lubricant from a metering feeder of the Trabon reversible system, but they may also be served by a portable hand gun, or by a manually operated pump attached to the machine, in addition to a full automatic system.

The pump is equipped with a reservoir of ½ lb. capacity; however, it can be furnished with reservoirs of 1 and 3 lb. capacity. Drive has a worm gear contained in the base housing which can be furnished in a wide range of ratios which will allow for various drive connections even up to full motor speed. The pump is easily adapted for drive by a chain and sprocket, V-belt, or gearing, whichever is most convenient. This pump may also be assembled with an overrunning clutch which is contained in the pump housing for applications where the drive is to be taken from a cam or some oscillating part of the machine on which it is installed.

STERLING PORTABLE PNEUMATIC SANDER

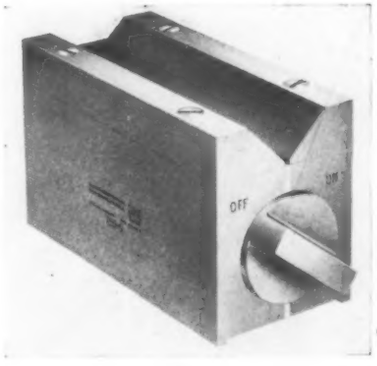
Sterling Tool Products Co., 363 E. Ohio St., Chicago, Ill., has developed the light-weight portable pneumatic sander which is adaptable to all types of finishing operations. Convenient to use in all positions and on wood, metal or composition surfaces, its flexible sanding pad permits the sanding of curved as well as flat surfaces.

Extremely rapid operation is assured by 3,000 strokes per min., each stroke being $\frac{3}{8}$ in. long. Only $6\frac{1}{2}$ cu.ft. of air at 60 lb. pressure per minute is required to operate the device.

The sander has a water connection for wet sanding. This water sprays over the work and is controlled by the "dead man" throttle, which also controls the air. Only one hand is needed to guide the machine.

ABRASIVE "BOROLIN" PRECISION GRINDING WHEEL

The "SB-Borolin" precision grinding wheel has been developed by Abrasive Co., Philadelphia, Pa., especially for use on Brown & Sharpe surface grinding machines. This wheel measures 7x$\frac{1}{2}$ in., and has a $1\frac{1}{4}$-in. hole bushed with a wear-resistant material. This bore is finished for a tight fit on the wheel spindle. The wheel itself is also ground on the sides and is available in a wide range of grain and grade specifications for use on all types of alloy and carbon steels.



BROWN & SHARPE MAGNETIC BLOCKS

Added to the line of magnetic holding devices offered by Brown & Sharpe Mfg. Co., Providence, R. I., are the No. 750D magnetic V-block and the No. 124 magnetic chuck parallel. Both of these devices employ permanent magnets, thus requiring no connection to any source of power.

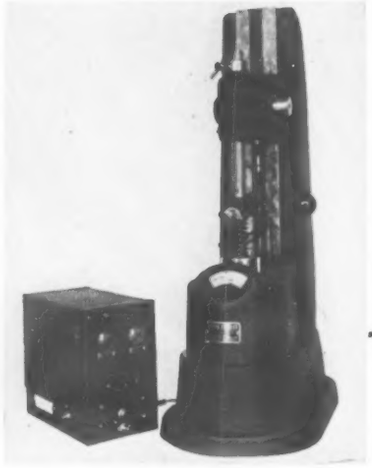
The magnetic V-block embodies a long cylindrical magnet which can be turned readily by a control at the front of the block to hold or release work placed in it. It requires no clamps. The parallels are intended for use on rectangular model magnetic chucks to aid in holding work of odd shapes. They are accurately finished for optimum holding strength.

DUMORE HIGH-SPEED HAND GRINDER

Extreme compactness, lightness and ruggedness has been combined in the No. 18 high-speed hand grinder developed by Dumore Co., Fourteenth & Racine Sts., Racine, Wis. Although this grinder develops a speed of 22,000 r.p.m., it has a temperature rise of only 16 C. Weight is only $4\frac{1}{4}$ lb. A feature is the spun glass air filter which prevents foreign particles from damaging motor parts. It can be supplied with either $\frac{1}{8}$ or $\frac{1}{4}$ in. capacity chuck.

LUFKIN "CHROME CLAD" STEEL TAPES

"Chrome Clad" is the name of a line of steel measuring tapes offered by Lufkin Rule Co., Saginaw, Mich. Markings are durable as well as easy to read. Tapes are chrome plated, with jet black markings and satin chrome-white surface, unusually free of glare. The permanent markings stand out in sharp contrast, showing up well even in poor light. Being built up by chrome plating, these tapes resist rust. The surface is smooth, hard, and easy to clean. Tape, being of metal throughout, will not crack, chip or peel. Cases and frames of improved design and appearance have been built for them.



LINK SPRING CHECKER

Link Engineering & Mfg. Co., 1054 W. Baltimore Ave., Detroit, Mich., offers the Model PB4 spring checker for testing compression springs and the Model PB4-D for testing tension springs also. In both models three capacities are available: 10, 50 and 250 lb.

When compressed-heights must be read closely a special 1-in. travel reverse-reading dial indicator assembly is offered. Where moderate quantities of similar springs are tested, the "Heightrol" attachment is used. For checking large quantities of similar springs, fully automatic electronic control is available. A neon lamp in a control box indicates whether a spring is within the tolerance limits for which the circuit is preset. The operator merely handles the springs. No special skill is necessary.

GENERAL ELECTRIC FRACTIONAL HORSEPOWER MOTORS

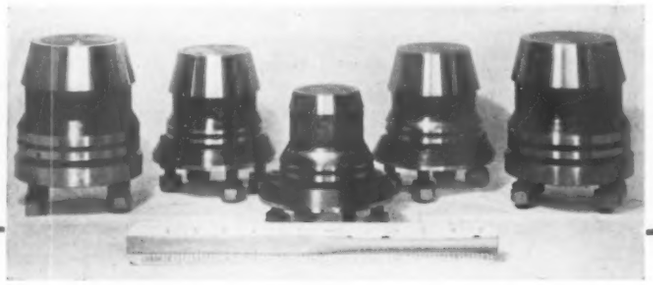
General Electric Co., Schenectady, N. Y., has brought out a new line of fractional horsepower motors designed for machine tool and industrial applications. These motors are of extremely sturdy construction and have been designed to meet the severe operating requirements of machine tool and industrial uses. The ball bearing totally inclosed construction is standard.

READY BALL BEARING CENTERS

Ready Tool Co., Bridgeport, Conn., has introduced several improvements to its line of ball bearing centers. Prominent among them is a ball bearing center made with a butt welded high-speed steel point, which has been found to give from five to eight times the life of those made with ordinary tool steel points.

Another improvement is a ball bearing center with a replaceable high-speed steel point, so that when one point is used up a new one can be inserted, thus renewing the life of the center.

Illustrated is a type of center which has been developed for such machines as Potter & Johnston automatics where certain form cuts must be taken on work of large diameter and in which the final finish must be absolutely true and free from chatter caused by work or tool vibration.



HUOT DRILL INDEXES

Huot Mfg. Co., 128 E. Tenth St., St. Paul, Minn., has added three more sizes to its line of drill indexes. This combination drill stand and indexed container also provides tap information and decimal equivalents.

All holes are individually drilled. Panels of drills fold into the box like the pages of a book. Drills will not fall out of place, even though they are shortened by breakage, sharpening or long use.

TOWMOTOR HEAVY DUTY HOIST TRUCK

Several improvements have been incorporated in the Model LT-53 heavy duty truck offered by Towmotor Co., 1226 E. 152nd St., Cleveland, Ohio. This truck features fast turning, easy acting steering mechanism, heavy duty four speed transmission and direct drive oil pump supplying hydraulic lifting and tilting mechanism.

The frame of the machine, which includes a massive rear bumper, protects all working parts and keeps them in alignment. Although there is more room for the driver, over-all width is but 40 in. and length without forks is only 90 in. Turning radius of 78 in. permits turns in 6½-ft. intersecting aisles. Load carrying capacity is 6,000 lb.

JOYCE-CRIDLAND "MATERIALIFT"

A simple hydraulic unit is used to provide pressure to the "Materialift" material-handling device developed by Joyce-Cridland Co., Dayton, Ohio. This device is suitable for use as a ramp eliminator, machine feed table, loading platform, short industrial elevator, etc.

Power is supplied either by a self-contained electric motor or by compressed air. Control is by hand lever, foot valve, push button or pull cable as desired.

BLACK "HARDSTEEL" DRILLS

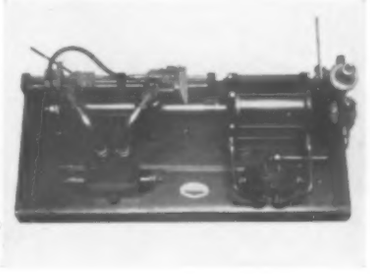
Black Drill Co., Cleveland, Ohio, has developed "Hardsteel" drills for drilling holes in hardened steel. With these tools it is said to be possible to drill, counterbore, countersink and tap steel having a hardness up to 80–82 Rockwell C, the holes having the appearance of having been reamed and polished and being suitable for dowel pins without additional operations.

These drills are available in sizes from 1/64 to ½ in. in solid "Hardsteel" metal, with straight shanks. They are also made from ½ to 1½ in., tipped with "Hardsteel" metal.

FAUVER MATERIAL MEASURING UNIT

An accurately measured volume of viscous lubricant or plastic can be transferred from a container with this automatic measuring unit developed by J. N. Fauver Co., 91 Selden St., Detroit, Mich. This device comprises air and lubricant cylinders, two control valves to reverse the direction of flow of air and lubricant, an air pressure regulator and an airline lubricator, two blow valves and suitable mounting brackets.

The device is adjustable over a wide range. After the operator has started a cycle by releasing a conveniently located lever, operation is entirely automatic. Average cycle occupies about 4 seconds.



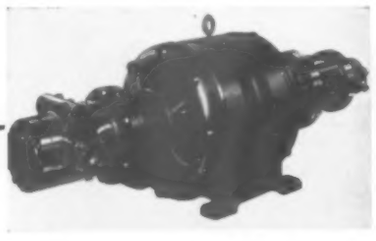
ALLEN FLAT-HEAD CAP SCREW

For assemblies requiring a socketed screw which will set up flush and stay tight when countersunk and seated in the regular manner, Allen Mfg. Co., Hartford, Conn., has developed a line of "Pressur-Formd" socketed flat-head cap screws.

Use of this process is claimed to produce a screw of exceptional strength and rigidity by making the steel fibers conform to the contour of the screw head and by preserving continuous fibers from end to end of the screw. Carefully heat-treated, these screws are made of "Allenoy" steel in 90 standard sizes from No. 4 to ¾ in.

VICKERS "MOTORPUMP" UNIT

A compact hydraulic power generator is available in the "Motorpump" unit manufactured by Vickers, Inc., 1400 Oakman Blvd., Detroit, Mich. These units are available with both single and double end motors, and with single or multiple pump mountings in sizes ranging from ¾ to 150 hp. Each is a complete unit, having inclosed flexible couplings and direct flange mounting of the pump upon the motor end bell. The only mounting provision required is for the motor feet. The problem of pump mounting and alignment is eliminated so that installation is greatly simplified and the space requirement reduced to a minimum. Units are available in open, splashproof, totally inclosed and explosion proof models.



BRUNING DEVELOPING MACHINE

Charles Bruning Co., 100 Reade St., New York, N. Y., is offering a new developing machine especially designed for use with the Model 75 BW printer. With this combination, one operator easily performs both printing and developing.

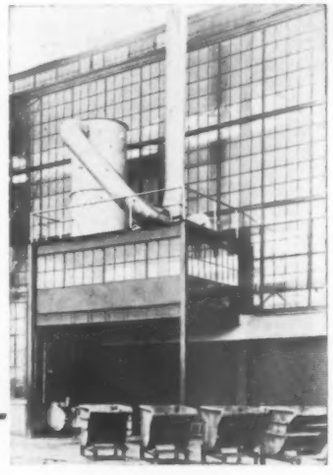
In operation, sensitized paper and tracings are fed into the machine at the front where they are immediately exposed in the printer section. A vacuum separator roll at the discharge point separates tracings from the exposed prints, allowing the prints to pass automatically to the developing and drying sections of the developer. The tracing is returned to the operator, while the completely developed print is delivered flat and dry at the rear of the machine. The developing section is driven by the printer and is synchronized to operate at the same printing speeds.

SCHNEIBLE "MULTI-WASH" DUST COLLECTOR

Claude B. Schneible Co., 3951 Lawrence Ave., Chicago, Ill., will display a transparent model of the "Multi-Wash" dust collector, a 10,000 cu.ft. per min. model of which is shown installed in an automobile factory in the accompanying illustration. These collectors are suitable for all types of grinding, polishing and buffing operations.

In the installation shown, the collector is inclosed by the railing. Collected dust as sludge is settled out in a dewatering tank in a glass-inclosed room below the collector. Accumulated sludge from the hopper is deposited periodically in the dump boxes shown in the foreground. Collectors of this type are available in sizes to handle from 400 to 30,000 cu.ft. per min. of dirty air.

To be announced at the show is the Model US dust and fume collector for individual use with grinders and buffers. This device is of the unit type with collectors, sludge pump and dewatering tank all contained in a streamlined cabinet. It can be plugged into any electrical outlet.



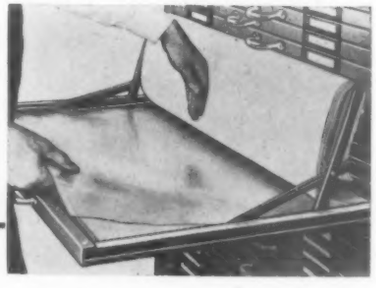
McKENNA "KENNAMETAL" TURRET LATHE TOOLS

McKenna Metals Co., 103 Lloyd Ave., Latrobe, Pa., has added two styles of tools for facing operations in turret lathes to its line of "Kennametal" tools. Known as Style Nos. 21 and 22, these tools have 6 deg. side and front clearance angles, 8 deg. end cutting edge angles, 6 deg. side rake and 2 deg. negative back rake. Style 21 tool (shown at top of illustration) has a 20 deg. side cutting edge angle which results in longer tool life. It should be used where a right-angle shoulder on the work is not required. For facing to a 90 deg. shoulder, Style 22 tool, which has a zero side cutting edge angle, should be used.

The negative back rake on these tools is made possible by the non-galling action of the material. Use of the negative back rake has the effect of imparting greater strength to the carbide tip. It will also be noted in the illustration that these new tools are supplied with chip breakers: Style 21 tool has a groove type chip breaker ground parallel to the side cutting edge, while Style 22 tool has a shelf type chip breaker ground 5 deg. from side cutting edge angle. Various other standard "Kennametal" tools will be displayed.

HAMILTON TRACING LIFTER FILE

Hamilton Mfg. Co., Two Rivers, Wis., has developed the "Calumet" tracing lifter file as part of a complete system of steel filing units which can be combined to meet any filing need in the drafting room. This tracing lifter is assembled into units which have ten shallow drawers. Each drawer is only 1 in. high, and accommodates 100 tracings. The lifter removes all weight from any tracing which is being filed or removed. In this way it eliminates tension and reduces tearing and crimpling of the paper, lengthening tracing life.



EXHIBITORS

Machine & Tool Progress Exhibition

CONVENTION HALL, DETROIT, MICH., MARCH 25-29, 1941

Abrasive Co., (113). Grinding wheels and abrasives.

Allen Manufacturing Co., (220). Socket screws.

Allis-Chalmers Mfg. Co., (145). Electric motors, V-belt drives, and coolant pumps. "Weld-O-Trons" (391).

American Broach Sales Co., (247). Tools with a miniature machine.

American Machinist (176). Copies of "American Machinist".

Ames Co., B. C., (367). Gauges and dial indicators.

Ampco Metal, Inc., (357). Non-ferrous alloys.

Anderson & Sons, (201). Imprinting machines and products.

Apex Machine & Tool Co., The, (172). Drill and tap chucks, collets, and nut setters.

Armstrong Bros. Tool Co. (274). Machine tools.

Atlas Press Co., (360). Lathes, drill presses, shaper and milling machine.

Automotive Industries, (226). Automotive publications.

Barber Colman Co., (100). Small tools.

Barnes Co., Inc., W. O., (135). Saws.

Black Drill Co, The, (351). Drills for metals.

Blake Co., Edward, (257). Grinders and tool holders.

Blank & Buxton Machinery Co., (159). Vertical milling machines.

Boggis & Co., Henry P., (216). Tap sharpening equipment.

Boice-Crane Co., (355-A). Drill presses, tapping machines, and power tools.

Boyar-Schultz Corp., (119). Screw machine box tools and grinders.

Bridgeport Machines, Inc., (353). Turret milling machines.

Bristol Co., The, (397). Socket screw products.

Brown & Sharpe Mfg. Co., (104). Machinists' tools.

Bruning Co., Inc., Charles, (132). Printing and developing machine.

Brush Development Co., (388). Surface analyzer and generalizer.

Campbell, Andrew C., Div. American Chain & Cable Co., (205). Wet abrasive cut-off machine.

Carboloy Co., Inc., (124). Carbide tools, dies and dressers.

Carborundum Co., The, (203). Wheels, superfinish stones, cylinder hones and sticks.

Carpenter Steel Co., The, (363). Properties and applications of tool steel.

Charron Engineering Sales, (234). Riveters, cylinders, hoists and trolleys.

Chicago Mfg. & Distributing Co., (332). Lathe centers, air separator, and blow valves.

Chicago Metal Hose Corp., (249). Metal hose and bellows.

Chicago Rivet & Machine Co., (114). Rivets and setting machines.

Cincinnati Tool Co., The, (322). Hand tools, and chisel tester.

Circular Tool Co., (163). Saws, center drills and reamers.

Consolidated Machine Tool Corp., (348). Die heads, milling cutters and chucks stud setters.

Conover-Mast Corp., (275). Copies of "Mill & Factory".

Continental Machines, Inc., (358). Surface grinder, saw blades, and variable speed pulley.

Crafts Co., Inc., Arthur A., (261). Diamond tools and gages.

Curtis Industrial Designing Engineers, (369). Metals and dies for airplane stampings.

Davis Boring Tool Div., Larkin Packer Co., Inc., (263). Boring tools, facing tools, and reamers.

Delta Mfg. Co., (139). Drill presses, grinders and cut-off machines.

Detroit Power Screwdriver Co., (155). Power screwdrivers.

Detroit Time Study Training School, Inc. (323).

Detroit Universal Duplicator Co., (403). Duplicator-Lathe combination.

DeWalt Products Co., (355-B). Cutting equipment for metal.

Dewar Manufacturing Co., (314).

Dietzgen Co., Eugene, (237). Drafting, surveying and reproduction equipment.

Dumore Co., The, (143). Grinders.

Duro Metal Products Co., (120). Rip saws, jointers, drill presses, and screw cutting lathes.

Esco Engineering Corp., (224). Drill jigs.

Farmer Co., Ray H., (405). Grinders, welding machine, drill chucks and cutter punch presses.

Fauver Co., Inc., J. N., (169). Hose assemblies.

Federal Products Corp. (267).

Firth-Sterling Steel Co., (235). Carbide tools.

Ford Motor Co., (276). Gage blocks.

Gairing Tool Co., The, (126). Standard and special tools.

General Electric Co., (107). Motors and control.

George Machinery Co., James W., (412). Saws, drills, grinders, punch presses, buffers, lathes and welders.

Goodspeed-Detroit Co., (380). Reamers, broaches, pumps and lathes.

Gorham Tool Co., (128). Forged high speed steel tools.

Graf Co., V. L., (118). Steel fittings, tubing, gauges and tube fabricating.

Grob Brothers, (150). Die making and filing machines, metal band sawing machines.

H & H Research Co., (379). Multi- purpose tools.

Hamilton Mfg. Co., (141). Drafting room equipment.

Hamilton Standard Propellers, (245). Airplane motor and propeller and parts.

Hammond Machinery Builders, (154). Grinders and polishers.

Hannifin Manufacturing Co., (243). Straightening press and cylinders.

Hardinge Brothers, Inc., (127). Collets for lathes and milling machines.

Hartford Special Machinery Co., The, (311). Milling machine vise, thread, gear and cam grinders.

Heim Co., The, (214). Die polishing machines, roller bearings, caster wheel and lapping machine.

Heller Brothers Co., (399). Hammers, files and masterenches.

Hitchcock Publishing Co., (272). Copies of various publications.

Holo-Krome Screw Corp., The, (156). Socket screw products.

Houghton Co., E. F. (116). Cutting oil, lubricant, rust preventives.

Hunt & Sons, C. B., (134). Valves and hose couplings.

Huot Manufacturing Co., (219). Drill indexes.

Illinois Tool Works, (270). Metal cutting tools, measuring machines.

Independent Pneumatic Tool Co., (273). Portable electric tools.

Industrial Equipment Co., (347). Hydraulic oil hose.

Industrial Press, The, (111). Copies of "Machinery" and engineering books.

International Nicket Co., Inc., The, (374). Nickel alloy metals.

Iron Age, The, (105). Copies of "The Iron Age."

Janette Manufacturing Co., (378). Speed reducers, converters, generators.

Jarvis Co., The Charles L., (144). Shaft machines, files, collets and nut setters.

Johnson Gas Appliance Co., (321). Heat treating furnaces.

Jones & Lamson Machine Co., (137). Comparators and measuring machines.

Joyce-Grindland Co., The, (376). Moteralifts and jacks.

Keuffel & Esser Co., (207). Drafting machines and drawing instruments.

Koebel Diamond Tool Co., (148). Dressing and boring tools.

LeMaire Tool & Mfg. Co., (365). Drill press, and notching machine.

Link Engineering & Mfg. Co., (117). Spring checkers, testers.

Lufkin Rule Co., The, (227). Measuring tapes and precision tools.

Lyon Metal Products, Inc., (359). Storage equipment for toolrooms.

McCaskey Register Co., The, (266). Tool control systems.

McKenna Metals Co., (345). Tools, blanks and lathe centers.

M-B Products, (121). Grinders, air line filters and lubricators.

Machinery Manufacturing Co., (356). Shaper, grinder, milling machines and jig borers.

Macklin Co., (161). Grinding wheels.

Mall Tool Co., (255). Portable power tools.

Manufacturers Sales Co., (153). Shaft machines and rotary files.

Marburg Brothers, Inc., (206). Jig borer, grinder, die and punch filing machine.

Martindale Electric Co., The, (221). Shaft equipment, files and burs.

Michigan Tool Co., The, (138). Gear cutting tools.

Michigan Unemployment Compensation Commission, (260). Describing the selection and placement of skilled men.

Micromatic Hone Corp., (108). Cylinder honing tools and fixtures.

Midway Machine Co., (300). Vertical milling machine.

Mid-West Hydro-Pierce Inc., (109). Power plants and machines.

Midwest Tool & Mfg. Co., (146). Precision metal cutting tools.

Minster Machine Co., The, (228). Presses.

Modern Machine Shop, (233). Publication exhibit.

National Broach & Machine Co., (102). Gear tester, cutting tools and broaches.

National Tool Salvage Co., (173). Assorted cutters and special tools.

National Youth Administration, (410). Metal grinder, shaper and drill press.

Nicholson File Co., (384).

Norton Co., (164). Abrasive products.

O. K. Tool Co., Inc., The, (244). Milling cutters, reamers, lathe, planer, shaper and boring mill tools.

Oakite Products, Inc., (354). Compounds for cutting, grinding, stamping, forming and cleaning.

Ohio Crankshaft Co., The, (202). Machine for surface hardening.

Ozalid Products Div. (106). Whiteprint machine.

Parker-Kalon Corp., (215). Socket screws.

Pease Co., C. F. The, (180). Blueprinting equipment.

Peters Co., The, (390). Tool design and tracing paper.

Pfeil, Inc., George H., (253). Stitchers, stapling machines and tackers.

Physicists Research Co., (112). Surface finish and profilometer.

Pike & Co., E. W., (371). Magnifiers and microscopes.

Pioneer Engineering & Mfg. Co., (239). Pumps.

Porter-Cable Machine Co., (208). Machine sanders-grinders.

Pratt & Whitney Division, (129). Cutting tools and gages.
Progressive Welder Co., (370). Welding equipment.
Pyro-Electro Instrument Co., (372). Hardness testers.
Racine Tool & Machine Co., (265). Pumps and valves.
Ready Tool Co., The, (160). Lathe centers, tools and grinder dogs.
Reeves Pulley Co., (122). Variable speed transmissions.
Robertson & Donaldson, (361). Metal cutting bandsaw.
Ross Operating Valve Co., (170). Air valves.
Rotor Tool Co., The, (238). Portable tools and drills.
Safety Socket Screw Corp., (328). Socket set screws, bolts and pipe plugs.
Scheer Co., George, (241). Precision tools.
Schneible Co., Claude B., (320). Dust and fume collection equipment.
Schrader's Son, A., (252). Safety controls and air ejections sets.
Screw Machine Publishing Co., Inc., (259). Issues of the magazine.
Scully-Jones and Co., (142). Production tools.
Severance Tool Mfg. Co., (349). Milling cutters and small tools.
Sheffield Gage Corp., (400). Gaging and measuring instruments.
Shakeproof Lock Washer Co., (270). Thread-cutting screws and lock washers.
Singer Sewing Machine Co., (223). Sewing machines.
Skilsaw, Inc., (217). Portable electric tools.
Smith Co., Roy, (302).
Snyder Tool & Engineering Co., (131). Special machine.
Sommers & Adams Co., The, (395). Vertical milling machine.
South Bend Lathe Works, (336). Precision lathes.
Standard Gage Co., (101). Gages, dial indicators and comparators.
Standard Shop Equipment Co., (262). Nuts, washers, clamp, wedges, blocks, and bolts.
Stanley Electric Tool Div., The Stanley Works, (213). Electric tools.
Starret Co., The L. S., (157). Tools and dial indicators.
"Steel", (168). Publication exhibit.
Sterling Tool Products Co., (373). Sanding machines.
Stokerunit Corp., (110). Boring machines.
Strelinger Co., The Charles A., (166). Steel and box stitcher.
Strong, Carlisle & Hammond Co., The, (115). Alloy steel screws.
Stuart Oil Co., D. A., (174). Machine tool lubricants.
Sun Oil Co., (389). Industrial petroleum products.
Sunnen Products Co., (350). Honing machines.
Super Tool Co., (133). Tipped tools.
Taft-Peirce Mfg. Co., The, (364). Gages and magnetic chuck.
Texas Co., The, (386). Cutting fluids and machined parts.
Tinnerman Products, Inc., (232). Nuts and clips.
Toledo Scale Co., (352). Scales and force measuring devices.
Tomkins-Johnson Co., The, (230). Cylinders and coolant pumps.
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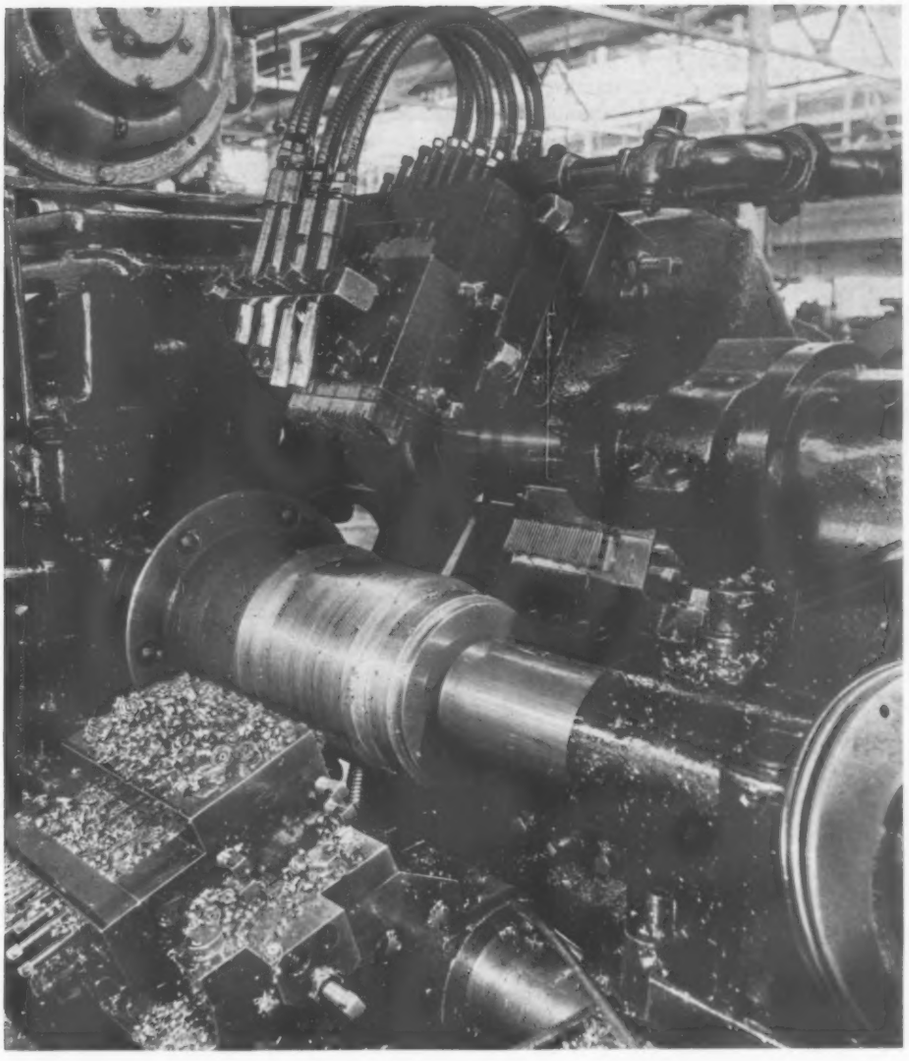


What Machinability Means to Defense

BY A. H. d'ARCAMBAL, CONSULTING METALLURGIST, PRATT & WHITNEY DIVISION, NILE-BEMENT-POND

With emphasis on the output of metal products, any attention given to tools and materials that will speed production is worth while. Here are some hints by an eminent authority

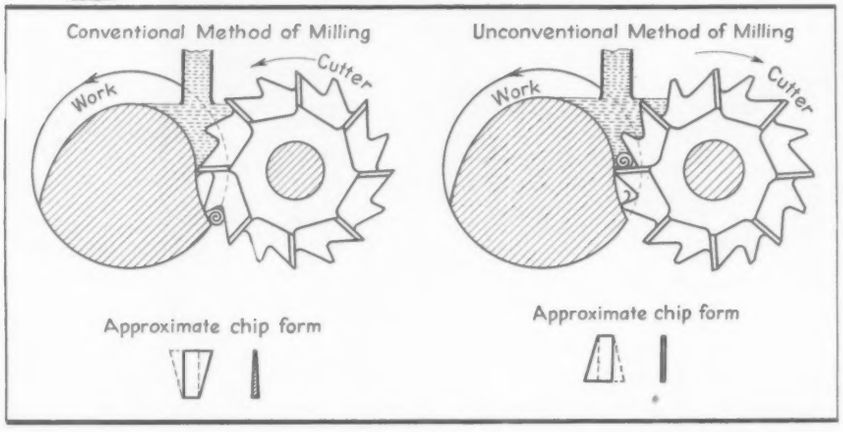
AT THIS CRITICAL PERIOD in history, with thousands of our manufacturing plants speeding into production on national defense, a few words on the machining of metals should be timely. Production in our metal-working plants is affected measurably by the machinability of many types of materials being fabricated on a tonnage basis. Quality and manufacturing costs are in no small manner dependent on the machining properties of the raw materials employed.

Careful consideration must be given first to the proper machine tools to be employed for the many machining operations involved in connection with the manufacture of planes, aircraft engines, instruments, guns of all types, shell, tanks and ships. The master tools of industry offered today are fortunately vastly superior to machines of only a decade ago. Improved design, proper use of alloy steels, ground gears, important parts held to tolerances closer than was considered possible only a few years ago, correct use of hydraulics, improved mechanical controls . . . all these factors and more have resulted in machine tools which today do their jobs at high efficiency. One cannot successfully manufacture these many and varied defense items so vital to the future security of our country without taking full advantage of modern machine tool precision. "A product is no better than the machine it is made on."

Correct tooling of these machines is

receiving more attention than at any time in the past. Through the employment of proper jigs, fixtures, tool-holding devices and cutting tools, parts are being machined at the highest rate of speed in the history of industry. Together with this high production rate, modern manufacturing plants are working to closer tolerances than ever before, obtaining better surface finish, and with it all, low costs.

One cannot emphasize too strongly the necessity of giving as much care to proper tooling as to the selection of the machine itself. Two companies manufacturing similar products using identical tools may show a marked difference in their manufacturing costs and quality of the finished product as a result of the difference in the tooling of their machines. Attempting to operate machines with improper tooling is comparable to attempting to fly a plane equipped with inferior instruments and poor quality fuel. In neither case is it possible to operate at anywhere near maximum efficiency. Another important consideration is that of bringing work to and from the machine. Recently a well known tool engineer cited several cases where merely by working out more efficient methods for bringing work to and from the machines, a production increase of 40 per cent was effected.



Under favorable conditions, climb milling (right) has advantages over the conventional method in better finish and higher production

High-speed steel precision cutting tools such as drills, reamers, taps, dies, cutters, hobs and the like, play an all-important role in connection with machinability. Machine tools of today are rightly called the "Master Tools of Industry," but precision cutting tools could just as correctly be named "The Indispensable Tools of Industry," as they constitute the cutting end of the machine. Many different types of materials are being machined today on a tonnage basis, such as magnesium, aluminum, brasses and bronzes, iron, plain carbon and alloy steels, the latter often heat-treated to a hardness as high as 400 Brinell before machining, stainless steels and high carbon-high chromium steels. Tools of a special design best suited for the material being machined are being used in ever increasing quantities.

Tools for use on magnesium castings, for example, must have high rake angles and clearances, ample chip room and smooth cutting surfaces so as to reduce friction to a minimum. Such tools as taps and reamers for use in magnesium usually are made larger than standard practice because of the work hugging the tool. Magnesium is claimed to be the freest machining of all common metals. Rating magnesium castings as 100, one investigator reports other metal castings to have the following ratings:

Aluminum	55
Brass	45
Iron	30
Medium carbon steel	20

Similar ratios exist for wrought materials.

High speeds and feeds should be employed when machining magnesium.

Milling cutters for use on magnesium castings should have high peripheral clearances, rake angles as great as 20 deg., and approximately half the number of teeth as regularly listed cutters. In contrast, cutters for use on alloy steels, treated to a high Brinell hardness, have only a small rake and small peripheral clearance.

While on the subject of milling, it should be of interest to mention that "climb milling" is being used on many operations with splendid results. The milling machine must be properly designed for "climb milling," all backlash eliminated, rugged spindle drive provided and outboard arbor supports used where necessary. With climb milling properly applied, production rates are stepped up, better finish secured, and cutter life increased. One thread milling machine builder provides his machines with a brake or drag on the work spindle which removes all backlash, overcoming the natural tendency of the cutter to pull the work ahead which is present in this method of cutting. This spindle drag is entirely automatic, operating during the cut only and disconnecting automatically when the rapid traverse is in use. This manufacturer recommends the use of climb milling on practically all thread milling operations whether using single or multiple thread milling cutters.

The proper selection of cutting tools for each of the operations is necessary to insure a quality job at a satisfactory cost. Experienced engineers representing the cutting tool manufacturers are working with representatives of manufacturing plants in selecting properly designed tools for the many operations in connection with defense projects. The correct use and care of cutting tools also deserves full consideration. Many of our industrial plants report substantial savings running into many thousands of dollars yearly in their machining costs as a result of the proper selection, use and care of small tools.

A large majority of cutting tools today are made from high-speed steel, although there is an increasing demand for cemented carbide tools. The price now asked for carbide is roughly ten per cent of that charged only a few years ago, resulting in a greater demand for this product. The cemented carbides now offered the trade, moreover, are superior in quality to the original material in this country some twelve years ago. Another important factor is our improved knowledge of design in carbide tipped tools, and the introduction of grinding wheels such as the diamond wheel for grinding and lapping these extremely hard cutting materials. Many steel jobs are being turned successfully and economically with titanium-tungsten or tantalum-tungsten carbides, not possible some years ago. The non-ferrous cast alloy of cobalt, chromium and tungsten also is being used for certain types of cutting tools such as turning and boring tools, and blades for inserted-blade cutters with excellent results, especially on cast iron along with some steel jobs.

Note: Part II, on the machinability of various metals, will appear soon.

Tools Make the Man

ALL-STEEL-EQUIP COMPANY
Aurora, Illinois

TOOL BOX CONTEST

TOOL BOX NO. _____ DATE: _____

Name of Owner _____ Score _____

	Excellent	Good	Fair		
A. Tool Box					
1. Quality of Box	11				
2. Special built-in improvements for better care of tools	14				
3. Cleanliness of Box	8				
B. Tools					
1. Assortment of tools for classification of work	10				
2. Quality	15				
3. Condition of	14	11	10		
C. Arrangement					
1. Grouping of tools	13	11	10	7	
2. Special effort for care of tools	15	12	11	7	
	100	80	70	55	TOTAL SCORE

Contestants in an annual toolbox contest held by All-Steel-Equip Company proudly display their prize-winning exhibits

Individual scores are calculated according to this rating chart. In general, the higher a man's score, the higher the quality of his work

BY A. F. ERICKSON, WORKS MANAGER, ALL-STEEL-EQUIP COMPANY

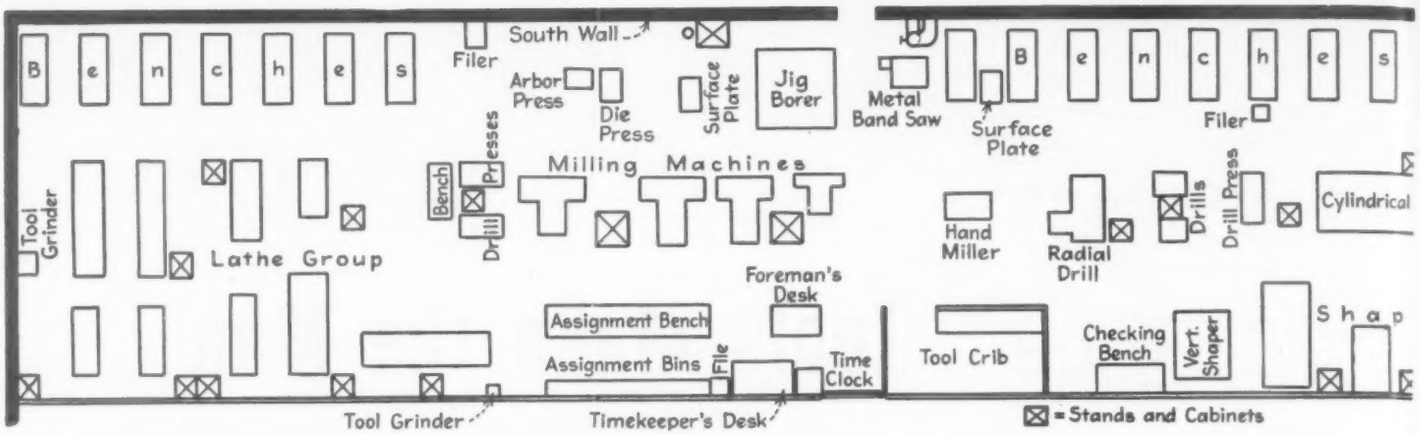
Pride in using nice tools is as old as tools themselves. Boost it and you boost work quality

THERE IS a direct relation between the care which a man takes of his tools and the quality of his work. Years ago we had difficulty in developing bench mechanics for sheet steel cabinet work. The men would come in to our plant to work in that department, with tools ranging in quality from bad to good. There was no standardization as to type, and many were not fitted for the kind of work that the mechanic was trying to do. For that reason, we furnished each employee a standard tool box which we had designed and made in our own plant. The men were permitted to purchase these boxes if they wished to do so and many have taken advantage of the offer.

We found that as soon as the men were furnished with tool boxes they immediately took interest in equipping themselves with the necessary tools. While the management furnishes a great number of small tools for the use of the mechanics, we encouraged the men to buy certain kinds of tools themselves. They seemed to take more interest in their work and become better mechanics when the tools were their own personal property.

Later we noted that the men were in friendly competition as to who had the best tools. To encourage this we started a tool box contest which now has been extended to include four groups of men: tool and die makers, tool and die maker apprentices, machinery and equipment maintenance men, and sheet metal cabinet artisans.

Boxes are judged by three disinterested men according to the points given in the table. Prizes are given to the first and second highest contestants in each class. In every case we like to give things that the men can use in their work or in their study or prepartion for the work they expect to do. We provide for prizes such things as steel tapes, combination squares, machinists' handbooks, dictionaries, and typewriting stands for the apprentices, all of whom take I.C.S. courses in connection with their apprenticeship. Pride in his work is sure to boost a man's morale.



Room for Tools

BY R. R. WIESE, CHICAGO EDITOR, AMERICAN MACHINIST

Not so long ago, the toolroom was given space not used by the manufacturing departments. Now shop managers realize the need of a well planned layout for this important plant activity

TOOLROOM ARRANGEMENT varies widely, although general practice is to group machines according to type. Grinding machines, for example, are usually segregated; the practice is designed to keep dust troubles at a minimum. Methods by which this is accomplished vary from placing the grinder department as far from other tools and benches as possible and providing exhaust dust collectors for dry grinding, to the practice of inclosing the grinding department in a glass-and-wood wall dust-tight room.

Jig borers, in the majority of cases, are in separate rooms. In practically all toolrooms, accessories and tools are kept at the machines, reducing trips to the toolcrib to a minimum. While conditions vary widely, there is a marked similarity in the efforts to reduce unnecessary steps. Layouts of two smaller and one large toolroom show typical tools and arrangements used.

JOHNSON MOTORS COMPANY

Within the past year Johnson Motors has established its toolroom in new quarters along the south wall of its plant. At the same time some 30 to 50 per cent of the equipment has been recently purchased.

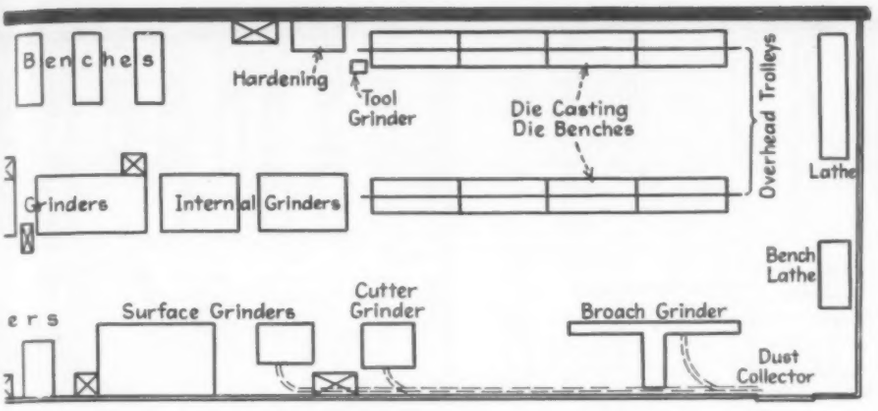
The toolroom is divided roughly into a department for the maintenance of die-casting equipment at one end of the shop, other maintenance and repair work at about the center of the shop and new work at the opposite end of the shop. "New work" includes tools, gages, jigs and fixtures or the machining of new or experimental design. Principal types of work in the production shop are die casting, press work and machining. The toolroom makes tools for these departments and in addition does all the grinding for the main tool crib used for production.

About 40 to 50 men are employed in the toolroom, including eight or nine men on the second shift, which represents about ten per cent of total shop employment at the present time. Included in the group are eight apprentice tool- and die-makers who attend school two nights a week taking courses in mathematics and kindred subjects.

Management and control in the toolroom is centralized. The foreman and timekeeper's desks are placed in the shop proper next to the entrance and across the aisle from the toolcrib. Nearby are the assignment shelves and tables. Procedure generally on new production is that the blueprint, tool order and the necessary material are

A tool cabinet containing all needed accessories for a jig borer saves time and steps in the Johnson Motors toolroom

Individual bench lathes at Sangamo are and grinding.. Each bench is equipped



Johnson Motors toolroom handles new work at one end, maintenance at the other and is supervised from a central position

placed in boxes on the assignment shelves. From there they are assigned in order of importance to the toolmakers or machinists. When one man has completed his portion of the job, it is returned to the assignment bench with the blueprints, ready to be moved to another machine or another department. Thus the foreman has a visual knowledge of the status of all work.

It will be noted from the accompanying layout that the machine tools are arranged somewhat according to type. The lathe department at one end of the shop has an operator for each machine with one lathe left open for the use of the bench men. Also conveniently at hand are drill presses and arbor presses. Nearby are the milling machines, among them one of the new rotary die millers which is used particularly on cavity dies for die casting.

The toolcrib, placed at the center of the shop, is used mainly as a source for drills and taps, precision tools and other accessories needed in die manufacture. Most of the accessories needed for machine operation including arbors, spindles and many cutters are kept in cabinets at the machines. Inasmuch as the night shift has no regular foreman, this permits the toolcrib to be closed at night and yet makes available the necessary tools without too much checking or paper work.

As the die-casting dies are fairly large, special arrangements have been made for their repair and maintenance. After they have been used for a time, it is necessary to clean off gummy deposits; large steel-covered wood benches along the wall and in the center of this department are made of convenient height for cleaning and doing other repair work on the dies. Handling is simplified by a portable lifter and by trolleys on I-beams mounted on the roof truss above the tables. Two of the older lathes, placed in this department, are used for turning and polishing pins and cores.

In the Johnson toolroom, bench men serve primarily for layout and assembly work. However, drills and lathes are available for some minor work which they may have to do. Otherwise the lathe operators, milling machine operators, shaper operators and grinding machine operators take over parts of the job.

SANGAMO ELECTRIC COMPANY

Unlike some companies, Sangamo uses toolmakers as job leaders and supplies them men required to do the various jobs. In some cases the leader may do all of the work on a small die himself, and in others, he will have several machinists and possibly apprentices working for him. Here again with the exception of bench lathes and drilling machines, operators are assigned to definite machines. Out of an employment of about 1,400 to 1,500 in the entire factory, there are 53 toolmakers, 22 of whom have been with the company fifteen years or more, and 9 apprentices.

Duties in the toolroom include making dies for plastic molding, die casting, blanking and other types of press work tools; inspection gages and fixtures; special machines; and screw machine products. The toolroom superintendent is also master mechanic of the plant; installation and maintenance of dies and machines are part of the duties of this department.

Machines have been divided into two groups, one at each end of the shop, thus minimizing material handling and reducing the number of steps. Benches are placed along the north wall and arranged so that one or two bench lathes are available for each row. These lathes have recently been fitted with individual drives and have accessories so they can be used for fine milling and grinding. Control is by foot-pedal switch leaving the operator's hands free for other work.

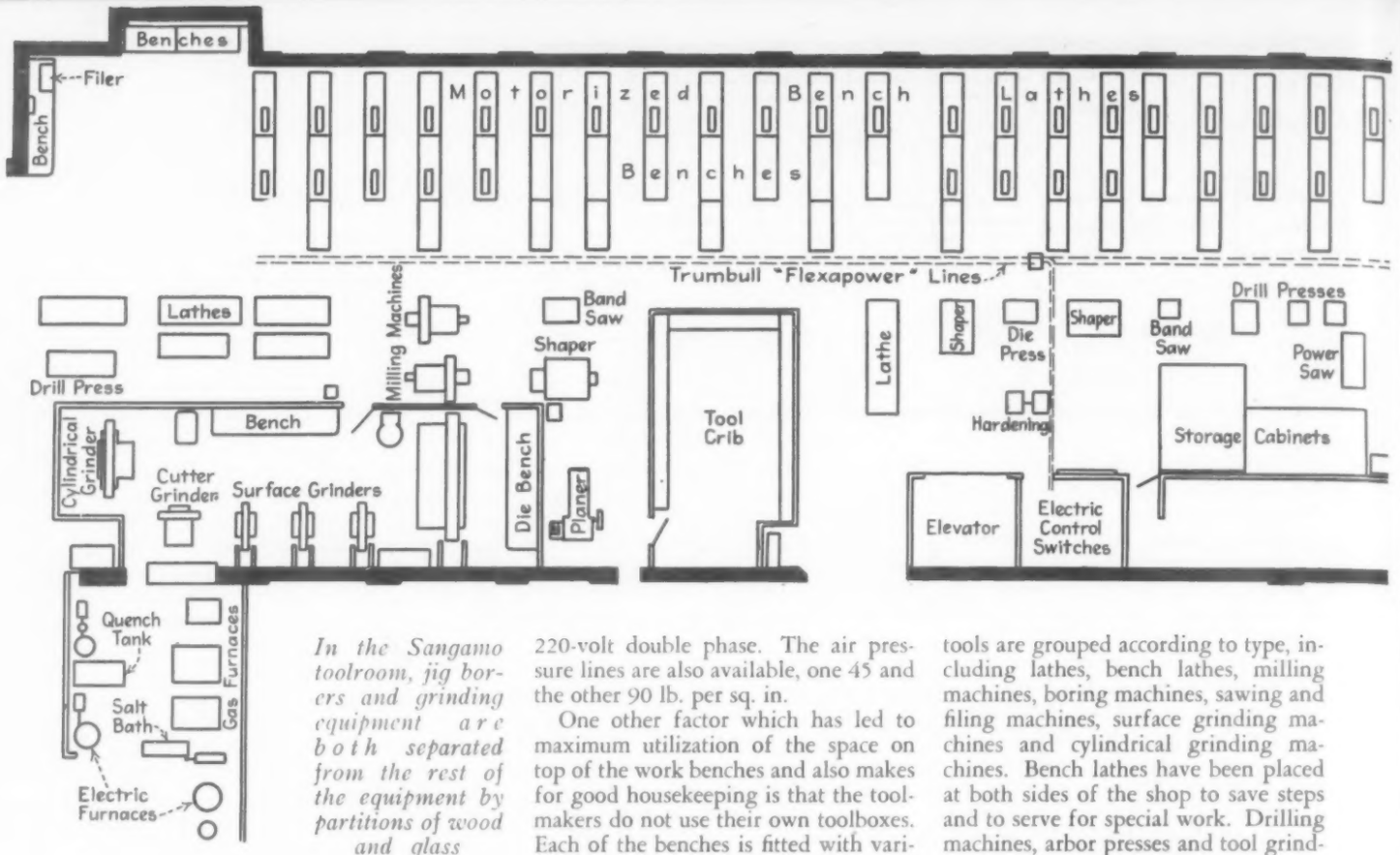
Recently the toolroom has been rearranged and every machine provided with an individual drive. A Flexa-Power duct has been installed the full length of the shop permitting electrical connections to be made anywhere along the line as required by the machine set-up or bench arrangement.

Another factor in the reduction of unnecessary steps is that the milling machines have been arranged according to type so that the accessories can be kept in one place and need not be moved back and forth across the shop to the other milling machine department.

All grinding machines, except for some small pedestal tool grinders have

provided with accessories for fine milling with drawers which can be locked

Both gas and electric furnaces are used in the heat-treating department at Sangamo. The nitriding process is used on high-speed steel



In the Sangamo toolroom, jig borers and grinding equipment are both separated from the rest of the equipment by partitions of wood and glass

been segregated in a wood and glass dust-tight room. The large Mattison surface grinder has been equipped with a special wheelhead. A much larger wheel than is commonly used makes it possible to sharpen the dies without removing the guide pins. In addition to reducing the amount of time required for die sharpening, it prevents the guide pins from getting out of alignment as they sometimes do when they have to be removed and reset.

A Pratt & Whitney jig borer and a Brown & Sharpe vertical milling machine are kept in another inclosed room. The milling machine is used for cavity work and is equipped with accessories such as a built-in gage and rotating table so that layouts can be made from any given center line.

As shown in the layout, the toolroom includes a heat-treating department where some production work may be done. Gas furnaces are used for drawing and tempering. A Vapocarb unit and a Lindberg cyanide pot are available. It has been found that the life of tools can be doubled or trebled by nitriding high-speed steels after they have been finally ground. This is done in a Hones furnace.

A space has been provided for machine maintenance and for trying out new machines. For convenience in making electrical connections, a switch and receptacle box has been provided which will furnish any type of power needed from 120-volt single phase to 220-volt double phase. The air pressure lines are also available, one 45 and the other 90 lb. per sq. in.

One other factor which has led to maximum utilization of the space on top of the work benches and also makes for good housekeeping is that the toolmakers do not use their own toolboxes. Each of the benches is fitted with various-sized drawers to hold the tools owned by each man. Each set of drawers is fitted with an individual lock, and the machinist carries his own key. The company carries insurance on them so that if there should be any loss the men are protected.

STEWART-WARNER CORPORATION

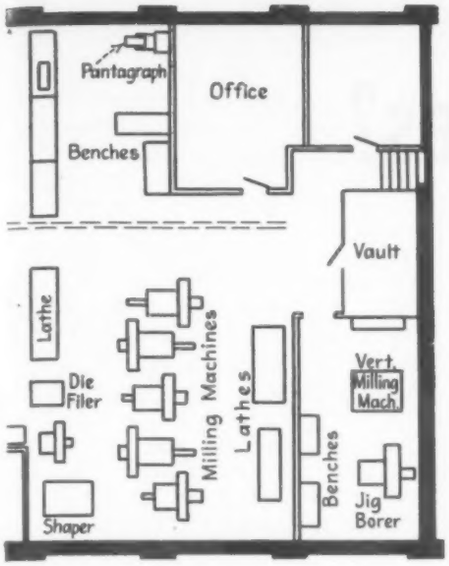
One of the larger toolrooms is that in the north plant of Stewart-Warner Corporation in Chicago. Employing over 200 men, this toolroom handles all the work for this plant, principal products of which are radios, car heaters, speedometer parts and lubricating equipment. A large percentage of this work is press work and screw machine work.

The toolroom is divided into four groups: tools and dies, gages, grinding, jigs and fixtures. At present the employment in these departments totals roughly five or six per cent of the total employment at the plant being: about 90 men on tools and dies, 35 on gages, 40 on grinding and about 80 on jigs and fixtures in two shifts. The tools and dies and grinding departments occupy about 19,000 sq. ft. on the third floor of a multi-story building, and the jigs and fixtures about 11,000 sq. ft. on the fourth floor of the same building.

The layout shown here is for the tool and die department, and grinding department. Benches for tool- and diemakers are placed along the south and west wall for best light. In general, the tools are grouped according to type, including lathes, bench lathes, milling machines, boring machines, sawing and filing machines, surface grinding machines and cylindrical grinding machines. Bench lathes have been placed at both sides of the shop to save steps and to serve for special work. Drilling machines, arbor presses and tool grinding machines are spotted at various places in the shop. The stockroom in one corner of the shop is supplied with three small cut-off saws and one automatic cut-off saw. Most of the machines in the shop are operated by specialists who follow the layouts made by the bench men. Some machines, such as bench lathes and drills, are kept open for the use of men working on the benches.

While most of the surface grinding machines are in the tool and die department, all circular grinding is done in the grinding department which specializes particularly on circular formed tools. Back-off tools are ground dry on machines equipped with exhaust collectors. All other grinding is done wet. Internal grinding is done on No. 2 universal grinding machines or on special internal grinding machines. All accessories for changing over from internal to external grinding on the universal machines are kept immediately available in racks at the machine. The grinding wheels are kept in the toolcrib to keep breakage to a minimum. Tool cabinets are placed near every machine to hold arbors, cutters and other standard equipment, thus reducing trips to the toolcrib to a minimum.

Large screw presses are available for checking the larger dies and fixtures. Two punch presses are also available for checking the operation of the smaller dies. Gas torches are available for hardening pins. A projection comparator is also accessible. It is ranged with a standard magnification of 20



and is used for checking all of the circular form tools for which it is equipped with suitable supports.

CATERPILLAR TRACTOR COMPANY

Given the problem of comparatively small lot production, no yearly models but a continual process of improvement and comparatively large parts, the Caterpillar Tractor Company had to arrive at a tooling solution which would maintain manufacturing costs at a profitable level and prevent the building up of large capital investment in machinery and buildings. At the same time precision and interchangeability had to be maintained in spite of the fact that set-ups are made to permit rapid changeover from one part to another.

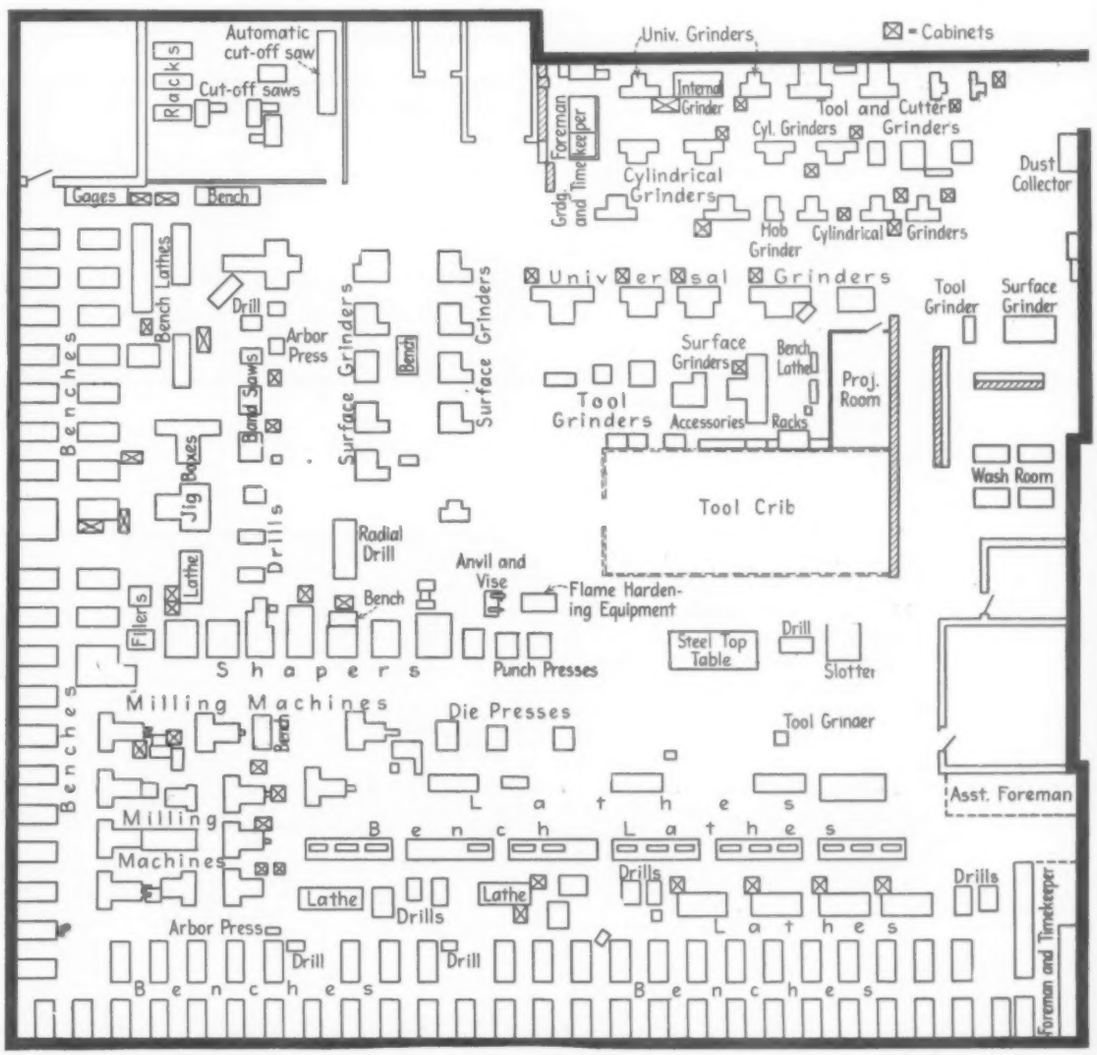
The machinery arrangement in the toolroom is now undergoing some change because the space allotted is to be increased. However, in general, the present and future arrangement will be according to machines as well as according to work to be done. From the functional viewpoint the shop includes a "new work" section, a jigs and fixture section, a repair section, a gagemakers' group, a special machine department, a machine maintenance group and a small inspection department. Of some 440 men employed in the tractor division toolroom on three shifts, about 120 are in the machine repair and maintenance department. This group includes men who specialize on grinding, automatics, gear cutting and so on. A separate toolcrib is maintained for this group in which a large supply of replacement equipment, such as V-belts, oil pumps, hydraulic and electric equipment, is quickly available.

The "new work" section, which includes most of the machine tools in the toolroom, has a flame-cutting and welding section (used for jigs and fixtures not requiring extreme precision); a heat-treating section, including furnaces for tool and die hardening; forging equipment; shaper and lathe section; grinding section; jig borer room; milling machine group and others.

A special repair section handles nothing but maintenance and care of air hoists and air motors. All of the necessary equipment is placed in this department and includes torque measuring devices.

Handling everything from the smallest of gages to dies weighing four or five tons requires that the first class toolmakers be used effectively. They operate from the bench, acting primarily as layout men and assemblers. The only machine tools which they use are a few surface grinders and drills which have been set aside for their use. Since each man works on several jobs at a time, upon him rests the burden of so planning the sequence of his work that the machine operators can do what is required in time for the bench man to meet his final assembly schedules. Unlike the other arrangements described, benches are not in one central position but are placed according to the needs of the various departments. For example, all of the pieces going to the shaper department are laid out by a bench man in that department. Thus, the toolmakers are relieved of the problems of preliminary rough layout, leaving them free to handle the later more precise work.

Caterpillar has found that it can satisfactorily meet the requirements of a production department employing about 12,000 men with a closely knit, well managed group representing at most five per cent of its total employment. Of 2,500 jobs on order, 400 are turned out each week.



Benches are arranged for best light along the outer walls in the Stewart-Warner toolroom. Grinding equipment is segregated but not partitioned off

Can't Use Carbides?

By W. J. BURGER, DIRECTOR OF ENGINEERING, THE WARNER & SWASEY COMPANY

Many men think that carbide tools are useful only on mass production. Here's a shop that made them work on small lots

UNTIL ABOUT two years ago, we thought of carbide cutting tools almost exclusively in connection with high-production work. Our company had tooled many of our customers' turret lathes for high-production jobs. But it took us a number of years to learn that carbide cutters could be applied to products in our own shop on parts made in lots of from ten to one hundred pieces.

Savings made on high-production work fully justify the replacement of other types of tools with carbide cutters; but a shop that does a large variety of small-lot work must consider carefully the cost of such items as new equipment, instruction of operators, and additional tools—expenditures which are costly when distributed over small quantities.

Our problem in installing carbide cutters primarily was to minimize the cost of the change-over. The obvious way to do it was to standardize a carbide tool set-up for our small-lot work that would require a minimum variety of equipment.

When we first began the work of carbide installation our plan was to start off gradually on a few simple cast iron jobs in the turret lathe department. With the experience gained on these jobs we then began the installation on the simpler steel jobs. At first we used two different types of cutters for turning and facing cast iron from the square turret, but it was found that a cutter ground as shown at *A* in Fig. 1 would serve both purposes. When it came to turning and facing steel, however, two different cutters had to be used because a combination tool would require a double chip breaker, which does not work satisfactorily. When not working to a square shoulder on steel, the tool shown in Fig. 2 proved the best. Tools shown at *A*, *B* and *C* in Fig. 3 for turning, boring and overhead turning are identical for cast iron and steel except for the use of a chip breaker and a different type of carbide on steel cutting tools. Two other cutters are particularly adapted for cast iron work—Fig. 4 for grooving and forming, and Fig. 5 for forming inside counterbores. The cutter shown in Fig. 6 was particularly adapted for steel bar work with universal turners.

We have found that most operations can be performed with only six different types of cutters for cast iron and eight for steel. Since extremely long tool life is not particularly important on small-lot work, the particular grades of carbide selected were those best designed for use on a wide variety of work. Four grades finally were selected—two for cutting steel, and two for cast iron and all other metals. In each case one grade is for roughing, the other for finishing and special work.

In general, tooling up the turret lathe department with carbide cutters for cast iron work was a simple job compared with the tooling required for steel work. At the present time about 85 per cent of all cast iron jobs in our shop are cut with carbides. This is just about as high as this figure will get because there are many jobs where either high-speed steel or Stellite is entirely satisfactory—jobs, for example, where a turned diameter and a drilled diameter are so close that the drill diameter limits the speeds of the outside of the piece. Thus it is not economical to turn that diameter with carbides. Likewise for grooving and for some forming work we have stayed with the less expensive high-speed steel cutters.

In the last three months we have increased the number of steel turning jobs using carbides about 100 per cent. At present, about 40 per cent of all our steel turning work is done with carbide cutters. Included are about 75 per cent of our bar jobs and about

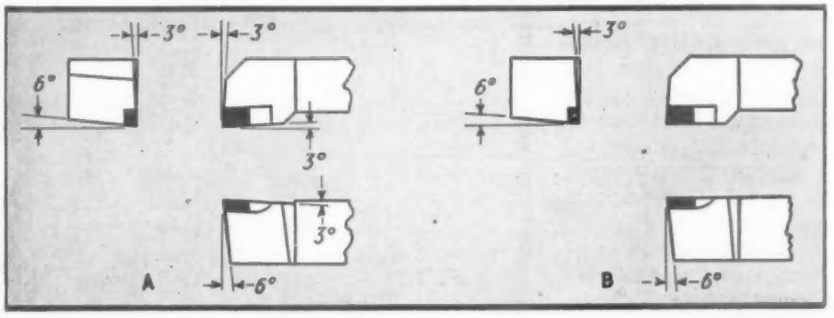


Fig. 1—The tool shown at A, *when properly ground, serves both for turning and facing cast iron. For turning steel, however, the slightly different tool shown at* B *works best*

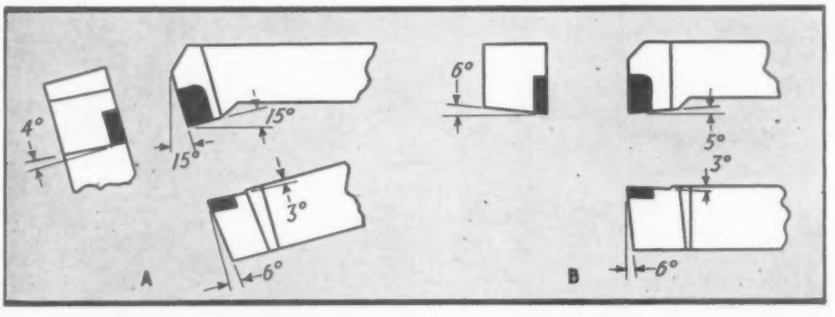


Fig. 2—When not working to a square shoulder, the tool at A *is suitable for facing steel parts. Tool* B *is employed when there are square shoulders*

75 per cent of our gear forgings. Here again this figure will probably never be any higher, at least for some time to come, because of limiting factors such as drills and forming tools.

From the beginning steel presented more problems than cast iron. One difficulty, for example, was the flying chips from steel cutting. These were blue hot and presented a serious safety hazard. Mechanical chip breakers were tried, in order to eliminate this problem, but they never worked satisfactorily. Chips would break and clear for a short distance and then would ball up and force the tip out of the cutter holder.

Other methods of chip breaking were then tried. First, the cutting edge of the tool was ground $\frac{1}{32}$ in. lower than the top surface, as shown in Fig. 7, thus causing the chip as it came off the work to hit the back of this step and break. This method did not prove satisfactory, however, particularly on medium and light cuts. The chips would curl downward and wear away the steel under the tip.

A variation of the step-type chip breaker, shown in Fig. 8, was then tried. The step was ground off at an angle. But again the chips would undercut the shank directly under the tip and the ground-off angle would limit the depth of the cut.

The third attempt at breaking chips, the chip groove, proved successful. This groove is ground on the top surface of the cutter parallel with the cutting edge as in Fig. 9. The land that turned out to be most successful measured one and one-half times the feed. In other words, when the feed is 0.020 in., the land should be 0.030 in. wide. The most satisfactory groove we found was usually between 0.010 and 0.012 in. deep. When the land is less than one and one-half times the feed the cutting edge will chip or flake and when it is more, the chip groove will be ineffective. The groove is put in with a metal-bonded, diamond-impregnated wheel 3 in. in diameter and $\frac{1}{16}$ in. thick. The cutter is held in a universal vise.

We have found that a 2-deg. negative top rake angle is the most satisfactory one for all-around steel cutting (Fig. 10). This angle prevents chips from pounding and wearing the exposed part of the cutting edge because it forces the chips up off the cutter. The side rake of the cutter is held to about 5 deg., but the land has a 2-deg. negative side rake angle. Here the tip forces the chips up away from the work and the cutter and it also gives more strength to the cutting edge. The side and front clearance are generally held to about 6 deg. on the carbide, but the shank clearance is cut to 8 deg.

For cast iron work the tips are brazed on two surfaces only, the bottom surface and one side. We make no attempt to fit these tips into a nicely milled recess, see Fig. 11. Since the coefficient of expansion of the tip is quite different from that of the steel shank, care must be taken to minimize danger of brazing strains. If the tip is held on two surfaces only, there is less chance of brazing strains and cracks developing than if it is held on three surfaces.

In this connection, two important exceptions should be noted. On box turning tools and steel facing tools we make the tips fit the recess completely. Otherwise, the open part of the recess might provide a place for the piling up of chips which might eventually force the tip out of the holder. The tips in the holders are left between $\frac{1}{64}$ and $\frac{1}{32}$ in. higher than the shank itself.

All of the soldering or brazing is done by torch, using a solder that melts at 1250 F. There are other solders on the market that melt at higher temperatures, but we feel that they offer no advantages.

We follow the conventional method of torch brazing. The shank milling is done in the plant. Experience has shown that the milled recess will allow the solder to adhere better if the finish is left rough. However, the tip supporting surface must be flat.

After brazing, the cutters used for

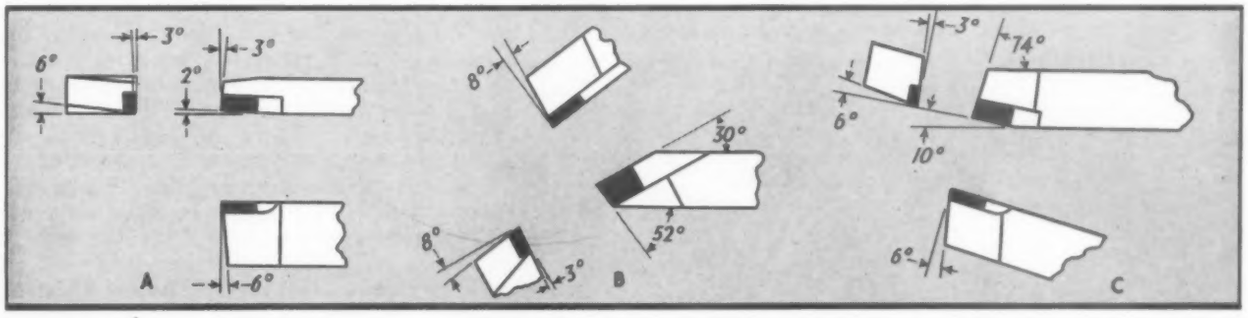


Fig. 3—The tool at A *can be used for turning both cast iron and steel, except that a different grade of carbide must be used for cutting steel. The same is true of tools at* B *and* C, *which are designed for boring and overhead turning respectively*

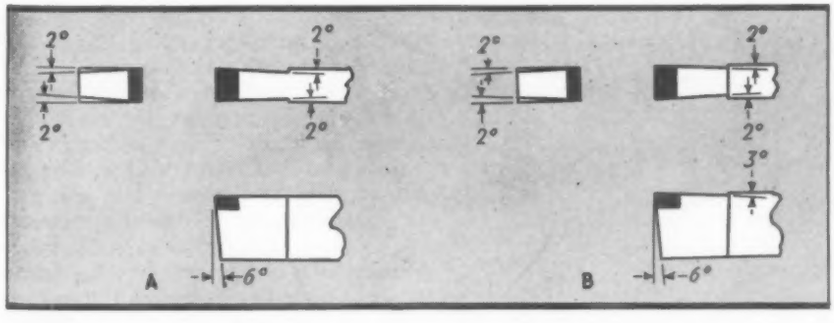


Fig. 4—Grooving and forming operations in cast iron call for a tool ground as at A, *while the tool at* B *is used for similar operations in steel*

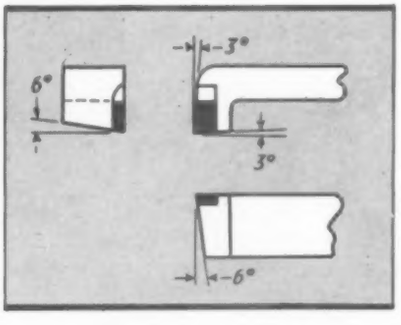


Fig. 5—Tools of this design are used for counterbores in cast iron

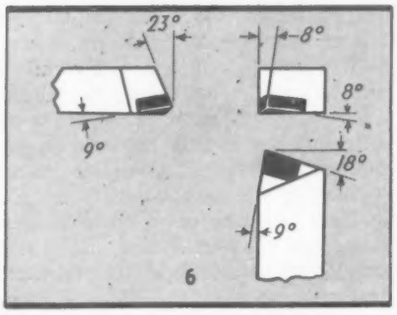


Fig. 6—This carbide-tipped tool is much used in universal turners for steel bar work

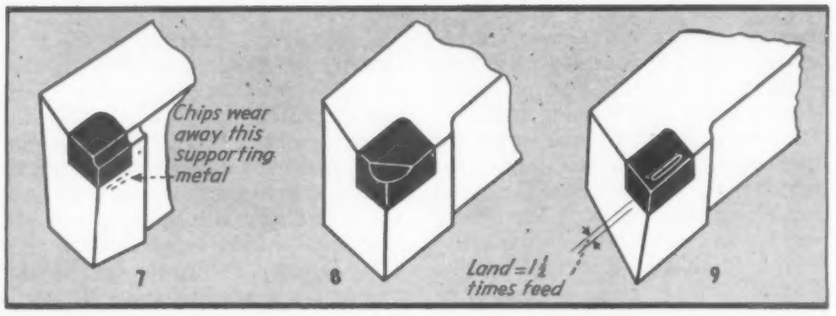


Fig. 7—With a chip breaker ground in the cutting edge $\frac{1}{32}$ in. lower than the top surface the chips curl downward and strike the metal supporting the tip. Fig. 8—Even when ground at an angle the step type chip breaker did not prove satisfactory. Fig. 9—Grooves 0.010 to 0.012 in deep located inside the cutting edge so as to leave a land equal to one and one-half times the feed proved most satisfactory of all chip control methods tried

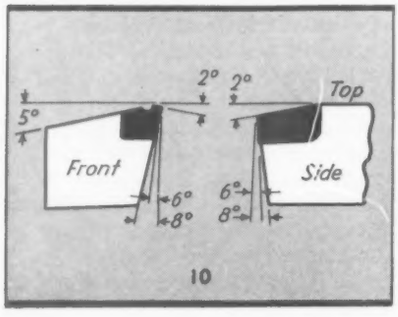


Fig. 10—Tip angles determined by test to be satisfactory for most steel jobs are shown. The negative top rake angle ground on the land in front of the groove forces the chips up off the cutting edge

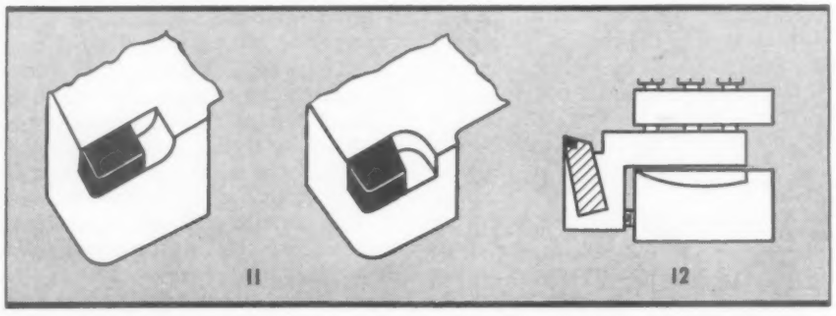


Fig. 11—For cast iron, tips are brazed to the shank on only two surfaces. Either of the two methods shown for milling the shank are satisfactory. Fig. 12—Carbide-tipped tools must have adequate support. Sometimes special tool holders must be devised

steel are put in powdered asbestos to cool. Cutters used for cast iron do not require this treatment. The rough grinding is done on a 10-in., 60-grit silicon carbide wheel. This wheel is used only to grind the carbide itself, since grinding the steel of the shank just loads up the wheel. Semi-finish grinding is done on an 80-grit, 10-in. silicon carbide cup wheel. The finish grinding or lapping is done on a bench grinder, using a 120-grit metal-bonded, diamond facing wheel. The better the finish on the tip, the more satisfactory the results. A good finish means that the cutting edge will be free of minute breaks and will allow the chips to move over the tip with the least possible resistance.

Cast iron cutters never need grinding while on the job; but when they are returned to the crib on completion of the job, they are always polished. On steel jobs the operator changes his cutters as soon as he gets evidence that they need sharpening. When he does make the change, he leaves a completed piece in the chuck so that he can easily set the new cutters to size.

Resharpening is simple. Square turret cutters require a touching-up on top and on two sides. Bar turner cutters require only touching up on the top side and deepening of the chip groove. Clearance angles no longer cause any concern in grinding this style cutter because it is set in the holder at such an angle that the entire shank clears the work.

As indicated, turning steel with carbide has presented a number of problems, but these are being solved one by one. For instance, when we first started to rough turn spindle forgings with carbide we had very unsatisfactory results. The tips which had to remove as much as half an inch of metal with a 0.020-in. feed would break out of the shank or the cutting edge would flake away. The cause of the failure, it was found, was lack of cutter support. A special holder, made to support a bar turner cutter, proved to be the solution to this particular problem. This type of cutter, shown in Fig. 12, has the supporting shank entirely below the cutting edge which makes for a more rigid cutter.

Another problem was the machining of forged gear blanks. Cutters would fail while breaking the scale. However, it was discovered that if the scale is broken with high-speed steel, the carbide cutter will work without any difficulty. There was still another problem with forgings. All our forgings are hand forgings, and consequently are not of uniform size. Depth of cut varies as much as $\frac{1}{2}$ in. The solution to carbide failures here lies in the use of drop forgings.

Carbide has not been successful on planers for several reasons. Chief of these is that only a few modern planers have speeds which can use carbides to advantage. This lack of speed creates a build-up on the cutter which inevitably leads to failure. Then, too, carbides will not stand up under the start of each individual stroke.

The successful use of carbides in any plant will depend mainly on two things. First, putting the equipment into the hands of some persistent and informed individual who will be responsible for the success of the program and, second, educating operators in proper carbide use. It is our belief that with coordinated effort directed along these lines, the difficulties which up to now have defeated so many attempts at carbide installations on small-lot work can be overcome.

The Small Shop Can Train Men!

BY O. L. HARVEY, U. S. DEPARTMENT OF LABOR

Only reason it often doesn't is that the attempted program is not suitable. Apprentice plan should match large plant's

APPRENTICE TRAINING is associated with big industrial plants in many people's minds. Some owners of small shops look upon it in that way. They feel it is one thing to take on a boy with a simple understanding that he is to pick up his trade the best he can; it is something else to put him through a formal and deliberately planned program of apprentice training.

A job shop is actually a good place in which to train a boy to become a machinist or a tool and die maker. Yet many small plants have had little or no training experience. Often the opinion prevails that big factories can afford to set up a training program and provide the necessary supervision, but the job shop hasn't the time or the facilities. Or has it?

First let us remember that a job shop is so called because it undertakes individual jobs. It seldom makes more than 10 to 100 identical pieces, and frequently will produce only one piece. The work, however, calls for the skilled use of any or all varieties of hand and machine tools. The craftsmen are equally adept on lathe, grinder, miller, shaper or drill.

Apprenticeship Problems

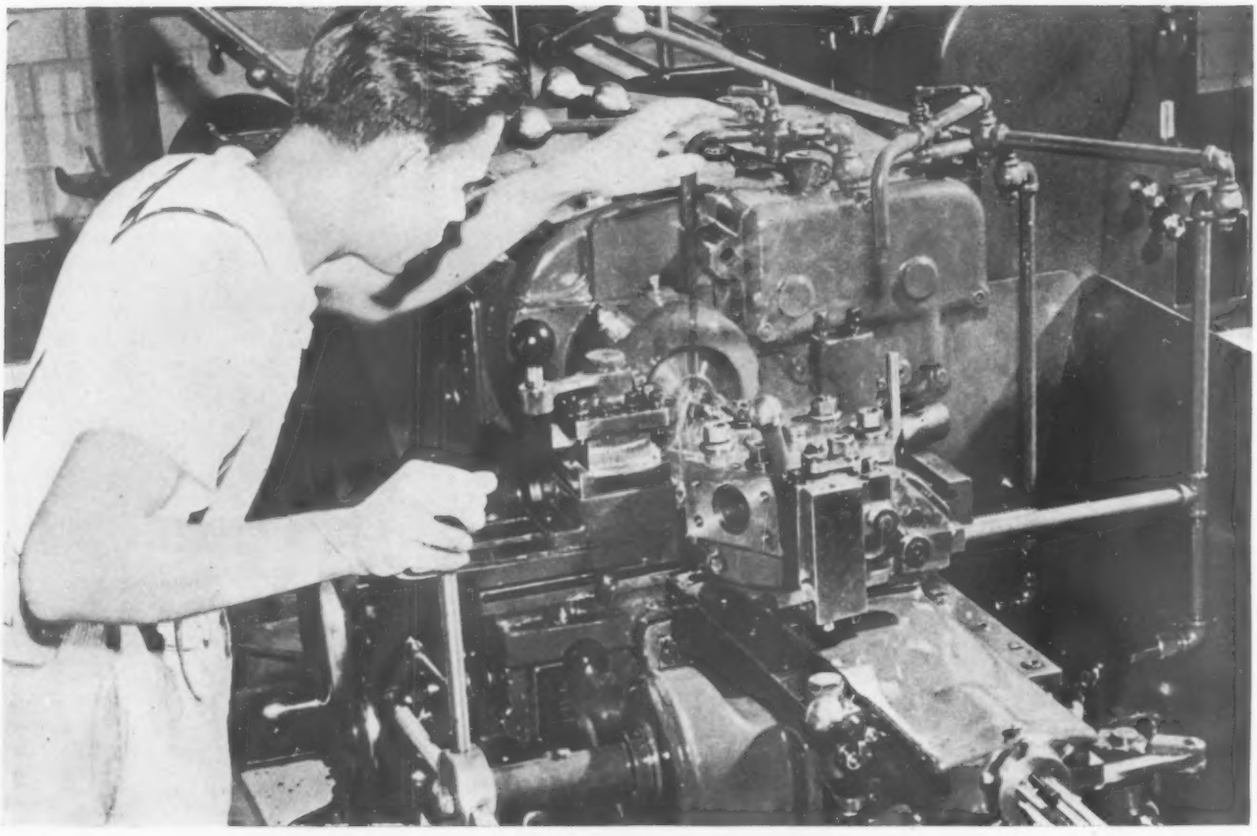
Let us consider a few of the apprenticeship problems, which some job shop owners claim, make it difficult to employ apprentices. Employers state:

That the apprentice prefers to work in bigger shops, where they pay higher wages; that the variety of work done in the job shop makes it impossible to lay down and agree to a fixed schedule of work processes providing for a specific period of training on each of several kinds of operation; that the supervision of apprentices in the small job shop calls for too much effort; that small job shops do not have adequate facilities for the training of apprentices that exist in large shops; that the training of an apprentice is a costly business.

Suggestions which might help are:

The apprentice is willing to be shown that the size of a shop is no measure of its adequacy as a training ground

Higher wage scales in small shops would aid training programs



Turret lathe operation is only a part of the skills taught in small job shops

1. Pay apprentices a reasonably adequate wage.

The average apprentice is drawn toward the supposed advantages of larger establishments. The bigger shops, he thinks, can offer more varied experience, more continuous employment, better opportunities and wider social contacts, as well as higher wages. The only way to cope with his tendency to quit is to guarantee him not only a sound training program, but also a wage that is a least as good as he will get elsewhere.

This is not an impossible task. Apart from the fact that many job shops actually can and do pay higher wages than are paid in production shops, few small job shops employ more than a couple of apprentices, with the result that the actual outlay in apprentice wages constitutes only a small proportion of total costs. Furthermore, provided the apprentice realizes that wages elsewhere are not markedly higher than his own, he will be willing to remain in his present employment. All attempts to make an apprentice satisfied that his present job is as good or better than others which he might have are due to have profitable effects on the small job shop owner. Good apprentices who remain with the small shop are money in the bank to the proprietor during this period of increased production.

2. It is not necessary that the proposed schedule of work processes to be taught the apprentice on the job should be either detailed or rigorously adhered to.

In scheduling processes the usual procedure is to list them in broad outline—so many months on milling machines, so much on lathes, etc. It is not necessary to specify in detail every machine and every operation. Nor does it follow that the apprentice is to work for the specified period of time on one type of operation before he may be transferred to the next. He can be shifted from one operation or machine to another as the need for his services arises, provided that the total amount of experience on that type of work is approximately that agreed upon. Furthermore, so as to permit of a little extra leeway here and there, some employers arrange to use up as much as six months of the boy's entire apprenticeship period in working him on machines of the employer's choice. More than that would perhaps be unfair.

3. Supervision of apprentices in small shops can be insured by placing one of the workmen in charge of apprentices and by making each apprenticeship responsible for his own bookkeeping.

Personal supervision in a small shop is easily provided. Indeed, it is probably true that the small shop apprentice gets better guidance and instruction every hour of the working day than does the apprentice in the production ship. His relationship with the employer and the journeyman is more intimate and personal, and he is more responsible.

It is recommended that the shop foreman, or one of the journeymen who has shown an interest in the apprentices, be appointed on a part-time basis as apprentice supervisor. His job would be to handle all apprenticeship problems on behalf of the employer; he would arrange the details concerning the progress of the apprentice through the various work processes, and see that the apprentice gets the necessary instruction. And he would be the person to whom the apprentice could come for advice when faced with some difficult problem.

So far as concerns the maintenance of a detailed record of apprentice progress, this problem can be overcome with very little difficulty. The apprentice is supplied with a card or booklet in which he himself makes the necessary notations, subject merely once a day to check by the (part-time) apprentice supervisor. The record lists: the type of operation or machine in which em-

ployed; the number of hours per day on that type of work; and some indication of the quality of his work (this last determined by the foreman). Periodically the apprentice submits his record to the supervisor who checks its accuracy, the quality of work done, and if appropriate, recommends to the employer that the apprentice be promoted to the next step in his training.

4. To hold apprentices more effectively, place them under a comprehensive written indenture.

The Federal Committee on Apprenticeship is of the opinion that the most effective way of holding an apprentice is to place him under a comprehensive written apprenticeship agreement or indenture. Most employers agree that this is a desirable objective; a few are vigorously opposed to it.

The written indenture constitutes a guarantee of intention. If either party to an indenture is unwilling to abide by its terms, he can easily strain the desire of the other to retain it. An indenture is no more effective than the will to abide by it. But as an initial commitment, expressive of since intention, its psychological effect is undoubtedly real. Thus, a written indenture serves to make both the employer and the apprentice more cautious about entering into an apprenticeship relationship and similarly cautious in breaking up that relationship.

Indenture Advocated

The written indenture, if properly prepared, provides a specific and detailed listing of the various types of operation the apprentice is going to be taught and the amount of his apprentice period that will be devoted to learning each type of operation. Thus the apprentice is fully informed about what he is going to learn and knows that he will be shifted from one operation to another in accordance with a well-defined plan; that his training program takes precedence over the employer's desire to produce; and that he should be able to finish his apprenticeship as a well trained all-round skilled worker.

In the written indenture, furthermore, provision is made for attendance at classes in related instruction. Where employers cannot give the apprentice the complete variety of training that he should have as a finished skilled worker the school is an aid. Not only can it provide the theoretical instruction so necessary to a full knowledge of the trade, it also can provide experience on special equipment for which the small shop has little regular use. The written proviso that the apprentice attend classes for a given and sufficient number of hours per week is, therefore, merely a further guarantee to both apprentice and employer that when the boy has finished his apprenticeship he will have had the necessary all-round experience.

A properly drafted indenture would also specify the wages the apprentice will receive during each period of his apprenticeship. Thus, once more, the apprentice knows what to expect. He subscribes to the contract with definite foreknowledge, and cannot claim that he was not informed.

Finally, if the indenture has been registered with some impartial third party, preferably a state agency administering an apprenticeship program, both parties to the contract should feel satisfied that its terms are reasonable An indenture thus registered is an excellent preventive of litigation.

5. Apprenticeship pays.

This is supported in opinions expressed by outstanding employers, and by actual published data on costs and production for a least two major manufacturing concerns. Additional testimonials are coming in daily.

To assist labor and employers, both large and small, in developing and improving upon their apprenticeship systems, Congress in 1937 authorized the Secretary of Labor to promote labor standards of apprenticeship. The Apprenticeship Unit of the Division of Labor Standards in the U. S. Department of Labor, therefore, has as its sole function the servicing of employer and labor groups in matters connected with apprenticeship. The unit employs a trained field staff strategically distributed throughout the major industrial areas of the United States, cooperating with state apprenticeship councils where such exist, and which is always available to provide technical help and advice on apprenticeship problems. The services of this staff are made available free of charge and without compulsion. If its help is needed, send a request directed to the U. S. Department of Labor, Washington, D. C.

Chrysler Now Making 75-mm. Shell

Both 75-mm. shell and cartridge cases now are being produced in one of Chrysler Corporation's plants. Each shell is marked with identifying data after the final machining operation

IDEAS FROM PRACTICAL MEN

Racks for Safe Storage of Piston Rods

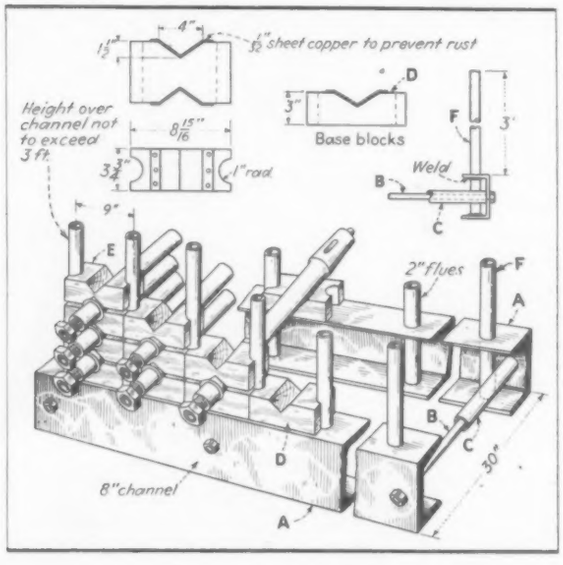
BY A. C. MILLER

One of the problems in a railroad shop is the storage of piston rods in such a way to prevent corrosion from water inherently in wood blocks, and from abrasion should they be piled one upon the other. These can be prevented by storing the rods in a rack such as shown the drawing.

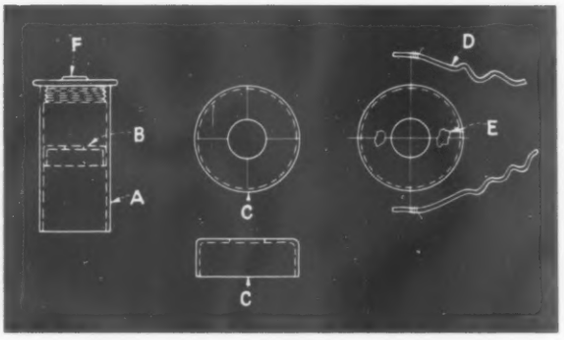
The base of the rack consists of two 8-in. channels *A* held in position by threaded rods *B* and spacers *C*, the latter of which are sections of scrap 2-in. flues. These spacers are located on 24-in. centers. The top flange of each channel is drilled on 9-in. centers to take sections of scrap 2-in. flues *F* which should not extend more than 3 ft. above the top flange. These uprights should be perpendicular to the channels and welded in that position on the underside of the flanges.

Base blocks *D* are flat on one side to rest on the channel flanges, and V'd on the top surfaces as recesses for the piston rods. Supplementary spacer blocks for stacking the rods are V'd on the top and bottom as shown at *E* in the drawing. The V-grooves in these blocks are sheaved with $\frac{1}{32}$-in. copper to prevent rusting from moisture which accumulates in the wooden blocks.

Each tier in the illustrated rack will hold five or six piston rods, depending on their size. Different classes of rods can be segregated in the tiers.



Locomotive piston rods can be stored safely in this rack without fear of corrosion or abrasion. Rods for different classes of locomotives can be segregated in the tiers



A microscope cannot be used as an inspection tool until cross hairs are installed in the lenses. This can be done easily by the method described herein

Microscope Equipped for Shop Inspection

BY ARTHUR K. BAKER

In the article "The Microscope as an Inspection Tool" (*AM*—Vol. 85, page 109), a fixture was described for checking the dimensions of a round part with protruding edges, using the microscope. The microscope was used because protruding edges prevented the use of a micrometer, and a sufficient quantity of parts were not manufactured to justify the making of special gages. In order to use the microscope for this work, it was fitted with cross wires such as provided in a surveyor's transit or level. Attention has been called to the fact that not all shop men know how to install such cross wires. The easiest method for doing this job is as follows:

Referring to the drawing, the ocular *A* is lifted out of the microscope, and the lenses are unscrewed from both ends. Measurements are made to determine the position on diaphragm *B* within the tube, so that after it is pushed out it can be put back into its original position. After removing the diaphragm it is set up on an angle block mounted on a surface plate and by means of a scribe block two deep lines are scribed at right angles to each other, as at *C*. Next fasten the ends of some very fine wire to the legs of a hairpin *D*. In our case we used 0.008-in. tantalum wire. The hairpin is used as a holder and a tensioning device for the wire. The legs are opened out and then squeezed back a little while the wire is being fastened to them and their natural spring hold the wire taut so that when it is laid in the deep lines made by the scribe block and cemented in position there will be no kink in the part across the opening in the diaphragm. After cementing the wire at *E* and breaking it loose from the hairpin at a point between the cement and the outer edge of the diaphragm, the diaphragm is put back in its original posi-

tion in the ocular tube and the lenses are screwed in.

When the ocular is reassembled in the microscope and a focus is made on an object, both the object and the cross wires should be sharply defined. If they are not, then the diaphragm must be shifted slightly. To determine which way it should be moved, unscrew the lens *F* almost out of the ocular tube and see if the cross wires are more distinct. If they are, then the diaphragm should be pushed a little farther into the tube. If the cross wires are less sharply defined, then the diaphragm should be pushed toward lens *F*. While the correct adjustment of the diaphragm can easily be made by trial and error, it is not especially critical in low-powered oculars which are the most useful in the shop.

Special Clamps are Time Savers

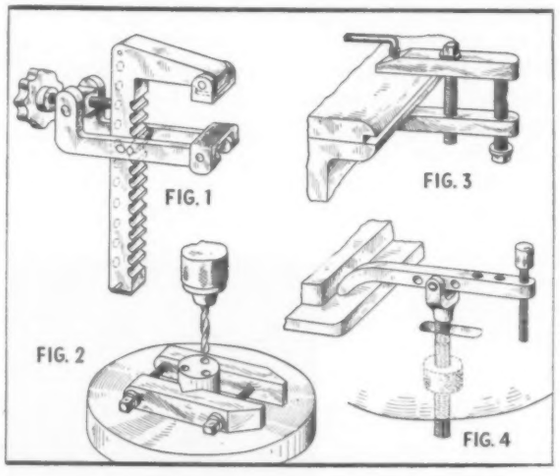
By CHARLES H. WILLEY

In the illustration are shown several clamps which we find extremely useful in our shop. The clamp shown in Fig. 1 has a short operating screw and a wide opening range, and as may be seen is rapid in adjustment over its entire opening. The point of the operating screw is located in spotted holes on the vertical bar of the clamp, and effects the clamping action by swinging the lower jaw about the horizontal pin as a fulcrum. The clamp is intended for ordinary work and of course cannot be applied where heavy-duty clamps are needed; however, it can be applied wherever the conventional C-type malleable clamp is used.

By the simple addition of small V's in the jaws of conventional toolmakers parallel clamps, as shown in Fig. 2, additional use can be obtained from them. This is especially true when holding round or square stock for drilling.

As an experiment I added a couple of socket-type setscrews to the jaws of my parallel clamp as shown in Fig. 3. They have proved to be worthwhile, since they prevent the clamp from slipping on uneven surfaces. Also, they permit added pressure being applied under the jaws when needed.

The clamp shown in Fig. 4 is of simple design and light construction, but is quite rugged and has a wide range. It has a series of tapped holes in the heel to permit changing the screw location, and a series of horizontal holes in the bar for adjusting the yoke on the hold down screw. It has proved exceptionally handy for drill-press work.



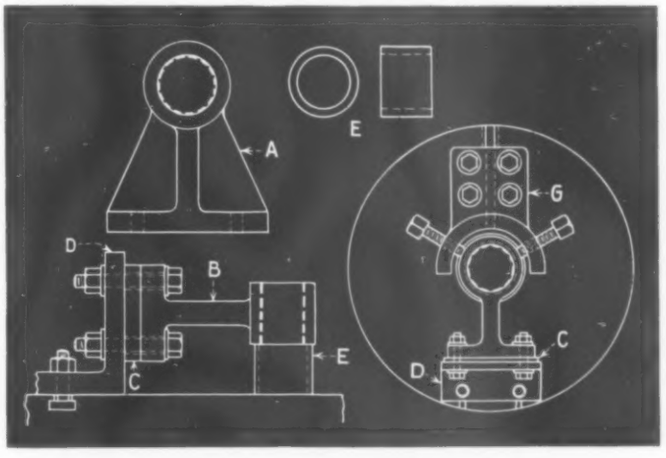
Here are four modifications of parallel clamps. The simple clamp with a socket-type setscrew in the jaw has been found exceptionally useful to prevent slippage and increase clamping pressure

Simplified Method of Boring Brackets

BY ARTHUR SILVESTER

Quite a number of engineering shops require a large number of cast-iron or bronze brackets similar to those shown at *A* and *B*. This is particularly true in the production of large printing presses. One concern has adapted the following method for saving time in boring the bearing.

Of the two types shown in the drawing, two or



Large brackets of similar shape which vary in height from the base to the center of the bore can be set up quickly for boring by inserting a hardened plate of accurate thickness between the base and an angle plate on the boring mill table

three dozen of each had to be bored and the only difference in their design is the height from the base to the center of the bore. For example, take bracket *A*—if after boring the bracket with maximum height of 8 in., the next lot of the same type has a maximum height of $7\frac{3}{4}$ in. from the base to the center of the bore it is only necessary to insert a plate *C* $\frac{1}{4}$ in. thick between the base of the bracket and angle plate *D*. If the height is $7\frac{1}{2}$ in. insert a plate $\frac{1}{2}$ in. thick. The brackets are all straddle milled on the bases for length required.

With the base of the bracket attached to the angle plate, the boss rests on Block *E* and is centered by Fixture *G*. Both the angle plate and fixture are provided with tenons to fit table. Once they are lined up,

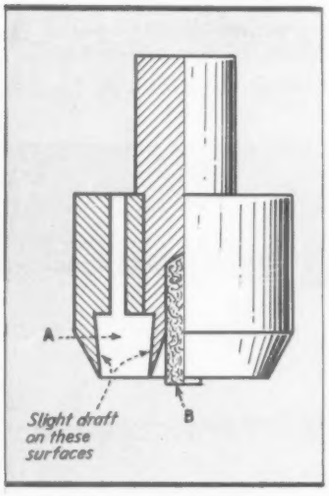
they need not be moved until all the brackets that come within their range are bored.

Prior to this method being adopted, it was necessary to reset the angle plate for every variation in height from base to the center of the bore, by putting a true turned plug in the bore of the milled table, centering the bracket, and using a length gage between the plug and the angle plate.

Accurate Washers from Thin Material

BY LAURENCE F. SOUTHWICK

The machining of thin fiber washers with the aid of a boring place, as described by the writer (*AM*—Vol. 84, page 924), is but one of the jobs which can be done successfully with this fixture. I have used it for making washers of steel and hard brass, for inside and outside toolpost grinding where exact concentricity is required, and for grinding or turning accurate eccentricities.



This dinking punch, with a slight draft on the inner surfaces of the annular recess, permits the accumulation of washers. A rubber block in the center of the punch ejects the center slug each time a fiber washer is cut

S. Arthur (*AM*—Vol. 85, page 13) has questioned the advisability of using the boring plate for making thin fiber washers, and offers as an alternate a hardened and tempered punch. Mr. Arthur states that a punch such as he describes can be made for $4, whereas the more flexible boring plate would cost $10. The boring plate can be made for less than this figure. But presume that it did cost $10, using Mr. Arthur's figures, you could only make two and one-half dinking punches for one boring plate. But when you have the boring plate, you can make any size of washer from any material, and produce as many washers as the boring plate will conveniently hold. For example, I made 100 fiber washers, 0.015 in. thick, and 1.370 in. outside diameter in 30 min. There is no doubt that the dinking punch has its place, but I believe that boring plate for making small quantities of washers from fiber, iron and brass, proves its value over the punch, especially in a shop such as ours.

Should one desire to use a punch such as described by Mr. Arthur, he might add the improvement shown in the accompanying illustration. Here, the walls adjacent to the cutter edges are tapered as shown, so that the washers can enter the annular space *A* freely, and then be ejected all at one time when the space *A* is filled. A small rubber insert *B* can be placed in the center to knock out the slug when a washer is cut.

Contrary Throttle Repaired with New Valve Seats

By NOAH DEERING

Continued grinding year after year on throttle-valve seats increases the diameter of the valve. The same is true of the standpipe that contains the throttle valve. In some instances this causes no trouble, but on a group of our Consolidated engines this oversize condition made the throttle open so hard that engineers complained daily about the inconvenience. Numerous steps to eliminate this difficulty were taken before it was discovered that the trouble was caused by the additional pressure on the oversize valve. Then there remained the problem of decreasing the size of the valve seat back to normal.

This was accomplishd by setting up the standpipe on a boring mill, and machining the tapered seat away, replacing it with a step-cut bore of sufficient size to take a cast-iron ring with a tapered seat machined in the ring. The replacing ring was ground to the bore and fastened in place with three equally spaced $\frac{5}{8}$-in. capscrews. The large seat on top of the throttle valve was machined to fit the new seat in the standpipe, which was made just large enough to permit the bottom valve seat to pass.

When these newly machined seats were ground, the reclaimed standpipe and valve were ready to serve their purpose as thoroughly and efficiently as when originally installed.

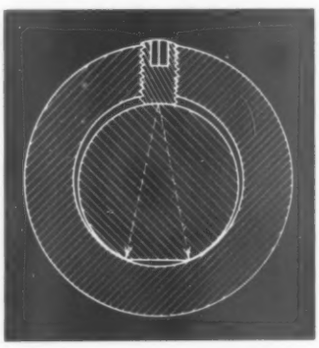
Flat Ground on Boring Bar Reduces Chatter

BY FRANK HUDSON

A new machine gave trouble from chatter in boring fairly long holes. It was perfectly satisfactory on all other operations. Any long bar has more spring than we often realize but this chatter seemed much greater than should exist in such a machine.

The boring bar was held by four clamping screws in a single line as indicated in the diagram. It was finally decided that the chatter might be due to the practically two point bearing between the clamping screws and the opposite side of the bar, for such a bar needs a fairly free fit to be readily handled in and out of the machine.

The boring bar shank was then flattened on the opposite side so as to provide a three point bearing, as indicated by the dotted lines. This seemed to cure the difficulty.



If a boring bar is flattened opposite the holding screws, a three-point bearing results which aids in reducing excessive chatter

Armament
SECTION OF AMERICAN MACHINIST

TOOLING SET-UPS FOR HIGH EXPLOSIVE SHELL—IV

BY BEN C. BROSHEER
Associate Editor, American Machinist

AFTER LOADING the shell into the fixture at station 1 in Fig. 93, it is indexed to station 2, where a two-bit boring bar rough bores for one-half the length of the nose section. The work is revolved at 112 r.p.m. for this operation, giving a cutting speed of 58 ft. per min. Feed is 0.015 in. per rev. The rough boring of the nose is completed at the third station, where the same speed and feed are used. Next, two facing tools at station 4 rough and finish face the end of the shell. Here, the speed is 106 r.p.m. and the cutting speed is 70 ft. per min. Feed is 0.0134 in. per rev. At station 5 the nose end of the shell is contour bored below the thread section, using a single tool bit in a bar mounted on a universal head. Spindle speed is 126 r.p.m., giving a boring speed of 76 ft. per min. Feed is 0.0186 in. per rev. Finish boring and chamfering is done with a boring bar having two high-speed steel bits at station 6, using 170 r.p.m. (90 ft. per min. cutting speed) and a feed of 0.0177 in. per rev. At station 7 the nose end of the shell is reamed with an inserted-blade cutter at 55 r.p.m. and a feed of 0.058 in. per rev. A plain vertical head with a positive lead cam carries the collapsible tap on the tool slide for station 9, where the nose end of the shell is tapped at 38 r.p.m. Machining time at each of the seven work stations for this set-up is 32 sec., giving an estimated production of 76 pieces per hour at 85 per cent efficiency.

Three tooling arrangements for machining the nose end of 155-mm. high explosive shell on Bullard 16-in. six-spindle Type D Mult-Au-Matics recently have been laid out. In each of these the first station is used for chucking in a power-operated collet fixture as in Fig. 93, then the succeeding five work stations are tooled differently. In the first layout, the second station is used for rough boring the nose in one operation, using two high-speed steel tool bits in the boring bar. Then, the nose end is rough and finish faced at the third station, contour bored at the fourth station, finish bored and chamfered at the fifth station, and tapped at the sixth station. Estimated production is 51 pieces per hour.

In another tooling layout for six spindles, the second and third stations are used for rough boring the nose end of the 155-mm. shell, each station boring halfway. Then, at the fourth station the nose end is rough and finish faced, and at the fifth station it is finish bored and chamfered. The nose then is tapped at the sixth station. Unlike other layouts for the nose end of the 155-mm. shell on Bullard Mult-Au-Matics, this layout does not include contour boring. Production is 76 pieces per hour.

In the third of the tooling layouts for finishing the

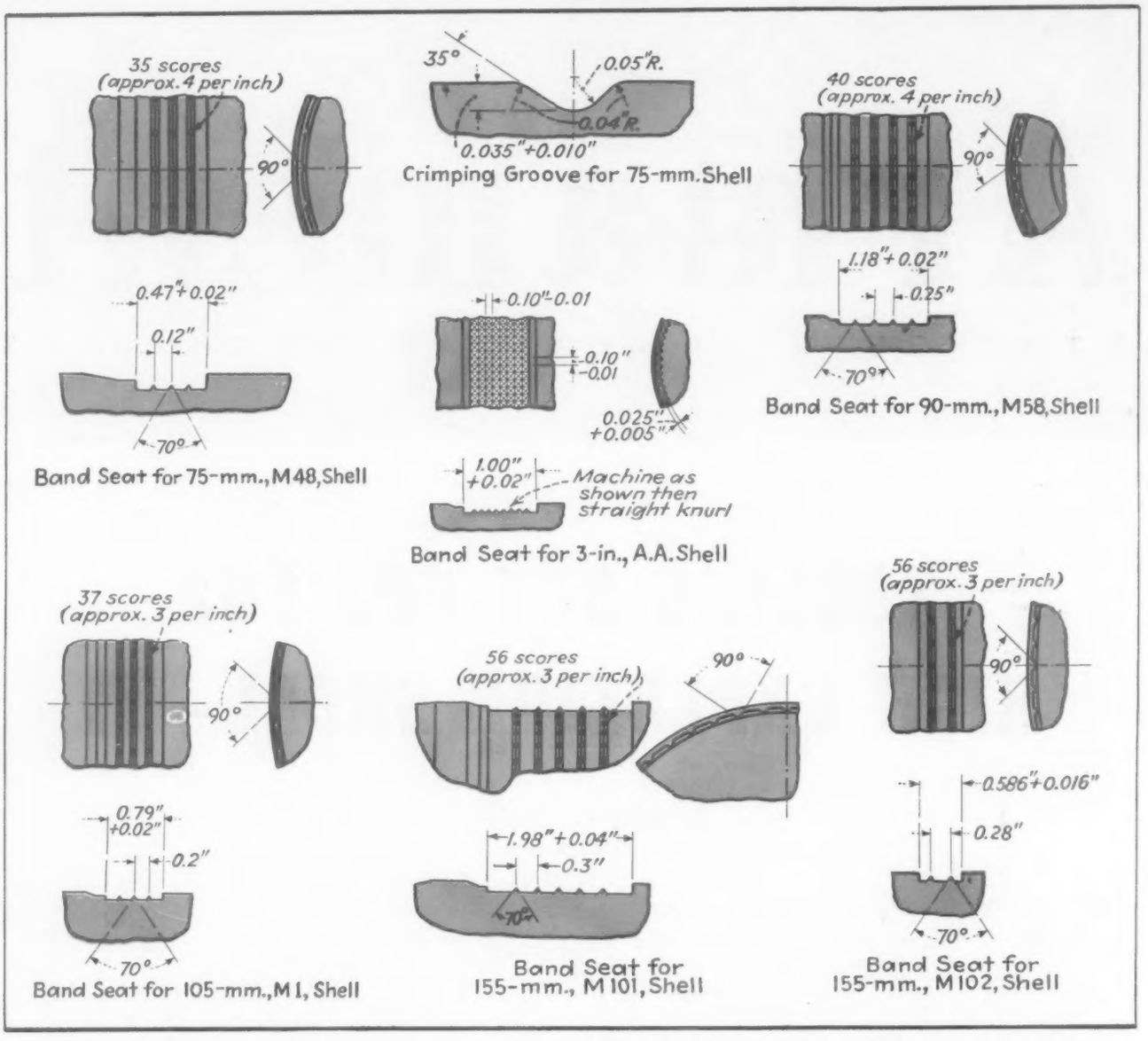


Fig. 94—Details of the band seats turned in the 75-, 90-, 105- and 155-mm. high exposive shell and the 3-in. anti-aircraft shell are given in detail above. There is considerable variation in band grooves turned in different sizes of U.S. and European shell, some require undercutting at each side of the groove and others require special toolholders and cams to produce a wave path around the shell

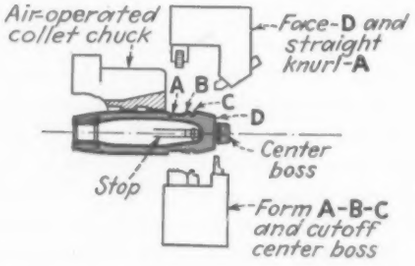


Fig. 95—Only the universal carriage is tooled for base-end operations when using a Warner & Swasey No. 5 universal turret lathe. Sometimes knurling is not done in this set-up, but is left for a following operation

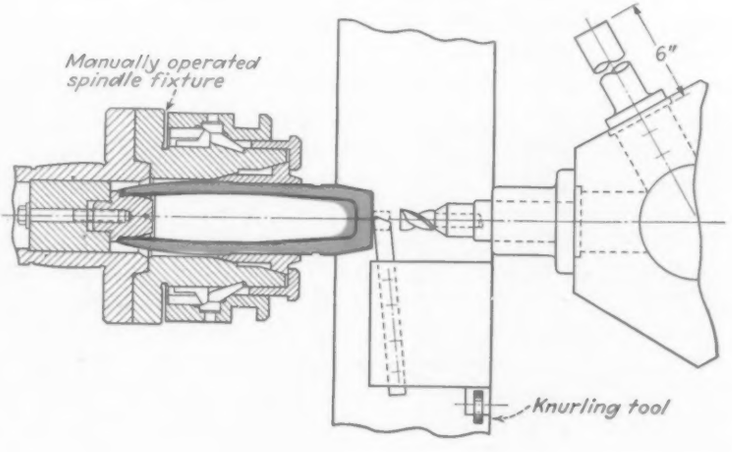


Fig. 96—When the 75-mm. shell has been finish turned and the nose end has been bored and faced, the shell body is faced on the base end and knurled in a J. & L. No. 5 ram-type universal turret lathe

nose end of 155-mm. high explosive shell on the 16-in. six-spindle Mult-Au-Matic, operations are the same as for the one just described, with the exception that nose is contour bored instead of tapped at the sixth station. This set-up was made for a machining lineup where it was desired to mill the threads in the nose end at another machine. Again, production at 85 per cent efficiency is estimated to be 76 pieces per hour.

Single-Spindle Base Operations

While the highest production rates per machine unit and per unit of floor space occupied are obtained when multiple-spindle machines for operations on the base end of shell, very satisfactory set-ups are possible on standard single-spindle machines where production requirements are not large enough to justify the higher cost of the multiple-spindle units. In two of these set-ups for base end operations on 75-mm. shell, it has been possible to include knurling of the band groove, which customarily is done as a separate operation. Details of band and crimping grooves for the 75-, 90-, 105-, and 155-mm. shell and the 3-in. anti-aircraft shell are shown in Fig. 94.

The tooling set-up for base end operations on a 75-mm. shell shown in Fig. 95 is for a No. 5 Warner & Swasey universal turret lathe, with all operations performed by tools mounted on the universal carriage. While the hexagon turret unit is not required for this set-up, it customarily is furnished with the machine so as to permit tooling up for the nose end operation, and so furnish reserve capacity in the production line. The collet chuck has an internal stop to locate the shell from the bottom of the cavity to insure facing the base end to the proper thickness.

When using the set-up shown in Fig. 95, the operator first form-turns the band and crimping grooves, and cuts off the center boss on the base end, with tools set up on the front turret of the universal carriage. Then, he reverses the direction of travel of the carriage to finish face the base and knurl the band groove with tools mounted in the rear turret.

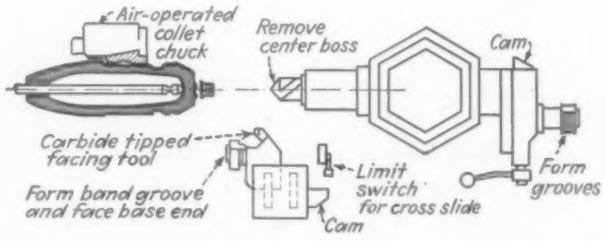


Fig. 97—Base end operations on 90-mm. shell can be performed on a No. 1-A Warner & Swasey turret lathe with this set-up. The band groove must be straight knurled later

Cut-off and facing tools on the front and rear turrets are set far enough ahead of the form turning and knurling tools that their operations are completed before the forming tools start their work. Cut-off and facing is done at 175 r.p.m. with 0.006 in. per rev. feed. A two-speed motor is used to drive the machine and when either the cut-off or the facing operation has been completed, the spindle speed is reduced to about 85 r.p.m. for the forming and knurling operations.

Another set-up for machining the base end of 75 mm. shell which includes knurling of the band grooves is that developed for a No. 5 Jones & Lamson ram-type turret lathe, as shown in Fig. 96. Here, the machine is equipped with a 3-in. capacity hand-operated collet chuck. A locating plug, in the spindle of the machine, centers the shell in relation to the finished bore and face of the nose end, and standard collet jaws grip the shell on the finish-turned outside diameter. A loading plug, held in the hexagon turret, is used to keep the shell firmly against the locating plug in the spindle while the shell is being chucked.

A two-lip high-speed steel end mill, held in the second hexagon turret station, is used to remove the center boss on the base end of the shell. The end of the shell is then finish-faced with a high-speed steel facing cutter held in the square turret on the carriage. A second position on the square turret holds a knurling tool for the band groove, which was form-turned during the finish turning operation. Spindle is run at 243 r.p.m. for the facing cut and 200 r.p.m. for knurling. These speeds give a surface speed of 70 ft. per min. for the end mill, and 85 ft. per min. for the facing cut. A feed of 0.015 in. per rev. is used for the end mill, and 0.022 in. per rev. for the facing tool. The knurling tool is fed by hand. A 10 hp. motor is used to drive the machine. Using the set-up shown and allowing 25 per cent over the actual floor-to-floor time, production is approximately 31 shell per hour. Where the knurling is not done in this set-up, but is performed in a following operation, the production per hour is increased to 38 pieces.

For base end operations on the 90-mm. shell, Warner & Swasey recommends the set-up shown in Fig. 97 on a No. 1-A universal hollow-hexagon turret lathe with 16¼ in. swing over the side carriage and $2\frac{1}{2} \times 35$ in. bar capacity. Prior to this operation, the shell is finish turned, and the nose end operations are completed. This permits gripping the shell on a finished diameter to maintain concentricity between the copper band and the bourrelet of the shell. The machine is driven with a special two-speed motor which will run the machine at standard and one-third standard speeds. Cams and limit

switches are provided on the cross slide and hexagon turret so that spindle speeds will be changed automatically without attention from the operator. A drill on the hexagon turret is used for removing the center boss. This is followed with a facing operation from the square turret with a carbide-tipped cutter. Both of these operations are run at 199 r.p.m. and the center boss drill is fed at 0.020 in. per rev., while the facing cut is taken at 0.011 in. per rev. feed. As the facing cutter completes its operation the cross slide is move longitudinally $\frac{1}{16}$ in. and at the same time a limit switch on the cross slide changes the spindle speed for the forming operation at the band groove. A high-speed steel circular form cutter is used to rough out the band groove and finish the cartridge case crimping groove. After the cross slide operations have been completed, the band groove is finish formed with circular form cutter on the hexagon turret. Forming of the band groove with tools in the square turret and the hexagon turret is done at 66 r.p.m. with hand feed. Upon completion of the form turning operation from the hexagon turret a cam again operates a limit switch to change the spindle speed back to normal speed for the first operations on another shell.

The Warner & Swasey tooling set-up for a 105-mm. high explosive shell is similar to that for a 90-mm. shell, except that it is used on a No. 2-A universal hollow hexagon turret lathe with 20-in. swing over the side carriage and is arranged for undercutting the band groove. Not all band grooves require this operation, but where necessary undercutting tools easily can be incorporated in a turret lathe set-up for base end operations. The work is rotated at 187 r.p.m. for removing the center boss with a drill on the hexagon turret and facing the base end from the square turret. Feed for the center boss drill is 0.020 in. per rev., and for the carbide-tipped end facing tool is 0.011 in. per rev. The forming of the band groove, the undercutting of the band groove sides and the forming of the groove are done at 62 r.p.m., all with hand feed.

The Warner & Swasey set-up on a No. 3-A universal hollow hexagon turret lathe shown in Fig. 98 is for a 155-mm. shell, and differs from other base-end set-ups just described in that it is arranged for forming waved bands in the band groove, as is necessary on some shell. Other elements of this set-up are similar to those shown in Figs. 95 and 97. Here, after the band groove has been form turned with a circular cutter on the square turret, this turret is rotated 180 deg. and a roll on the turret contacts a cam on the air-operated collet chuck to guide the form tool which produces the bands. The work is run at 93 r.p.m. for drilling the center boss and facing off the end of the shell with a carbide-tipped tool, with a feed of 0.020 in. per rev. for the drill and 0.018 in. per rev. for the facing tool. When the facing operation has been completed, the spindle speed automatically is reduced to 31 r.p.m. for the forming operations. Hand feed is used for the two forming tools and for the undercutting tools. In this set-up, the end stop is inserted into the shell prior to loading into the collet chuck, so as to avoid damaging threads tapped in the previous turret lathe operation.

Set-ups on the Gisholt No. 12 hydraulic automatic lathe with front and rear slides for finishing the base end of 75-, 90- and 105-mm. shell are similar. The only differences being the size of shell and the shape of forming tool used for the band and crimping grooves. In this set-up, shown in Fig. 99, the shell body is held in a special air-operated collet chuck supported in a ball-bearing steadyrest. First, the two carbide-tipped tools on the front slide cut off the center boss at the end of the shell and rough-form the band groove. Then, the front slide is retracted and the rear slide feeds forward to finish face the base end and to form the band and crimping grooves. Time estimates for this machine are based on the use of carbide-tipped tools on both front and rear slides. It will be noted that the shell is positioned in the collet chuck by a stop which locates the bottom of the shell cavity. The No. 12 automatic lathe used for this operation is driven by a 10-hp. motor to provide a cutting speed of 300 ft. per min. Feed for the front slide is 0.012 in. per rev., while feed for the rear slide is 0.006 in. per rev. Estimated floor-to-floor time per piece is 0.9 min. for the 75-mm. shell, and 1.0 min. for the 90- and the 105-mm. shell.

Gisholt base-end operations on the 155-mm. high explosive shell are divided between two machines as shown in Figs. 100 and 101. Both of these set-ups are for No. 3 universal turret lathes equipped with universal carriages, but without turret carriages. In the set-up shown in Fig. 100, the tapered boat-tail is finish-turned with carbide-tipped tool *A* in the rear tool post, which is equipped with a taper attachment, while the center boss on the base end is cut off with a high-speed parting tool *B* in a turret on the front slide and the base end is finish-faced with carbide-tipped tool *C* in the same turret. Cutting speed is 300 ft. per min., and the feed is 0.005 in. per rev. for tool *A* and 0.015 in. per rev. for tools *B* and *C*. Floor-to-floor time for this set-up is 4.0 min. A 5-hp. motor is used to drive the machine.

Final base-end operations for the 155-mm. shell as outlined in Fig. 101 are done at a cutting speed of 250 ft. per min. Here, the shell is located in the parallel-closing type collet chuck by means of a micrometer adjustable swinging stop supported on the

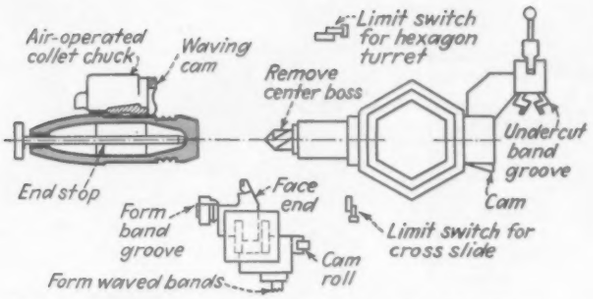


Fig. 98—Waving of the band groove in this Warner & Swasey set-up for 155-mm. shell is accomplished by using a special slide having a follower roll which is moved by a cam on the face of the collet chuck

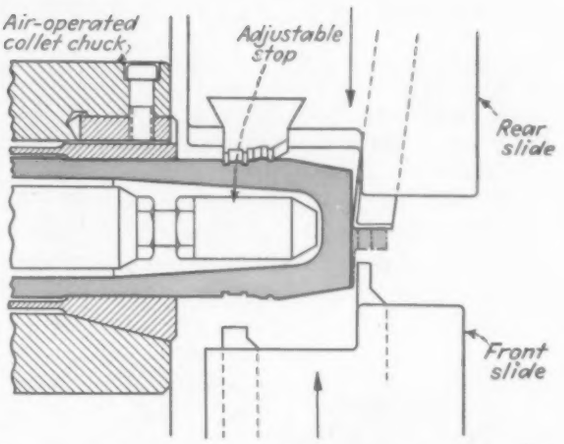


Fig. 99—Carriage of the Gisholt No. 12 automatic lathe used for base-end operations on 75-, 90- and 105-mm. shell is moved longitudinally only enough to clear the facing tools while cutting the groove, as tools in front and rear tool blocks are aligned with each other

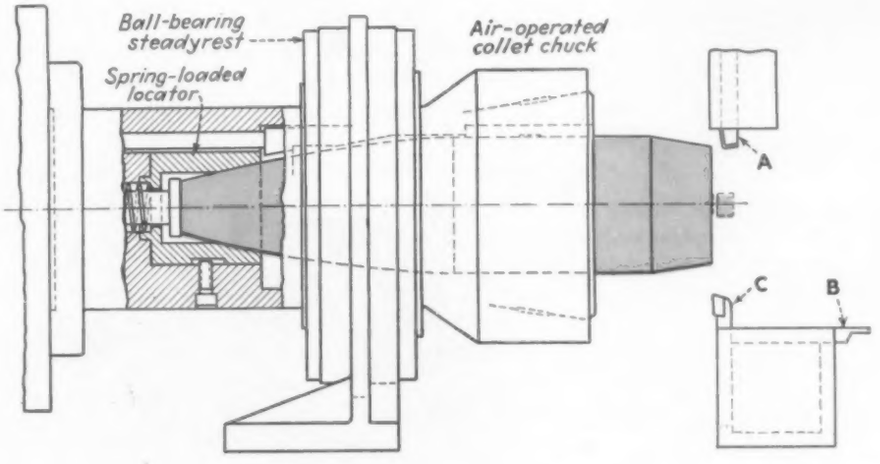
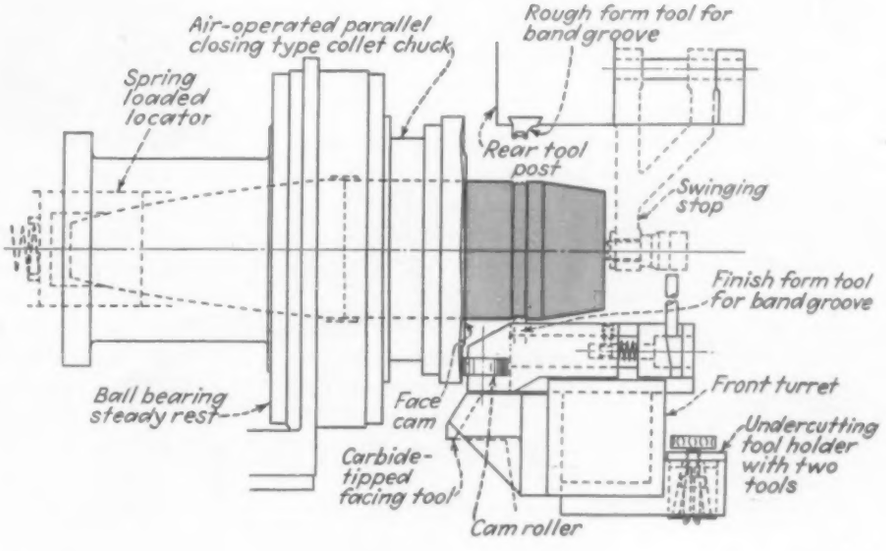


Fig. 100—Boat-tail is finish turned and base is faced in this set-up on a No. 3 Gisholt turret lathe for 155-mm. shell. Nose-end of shell is supported in a spring-loaded cup

Fig. 101—Final base-end operations on 155-mm. shell are done with this Gisholt No. 3 turret lathe set-up when ribs in the band groove are waved and sides of groove are undercut



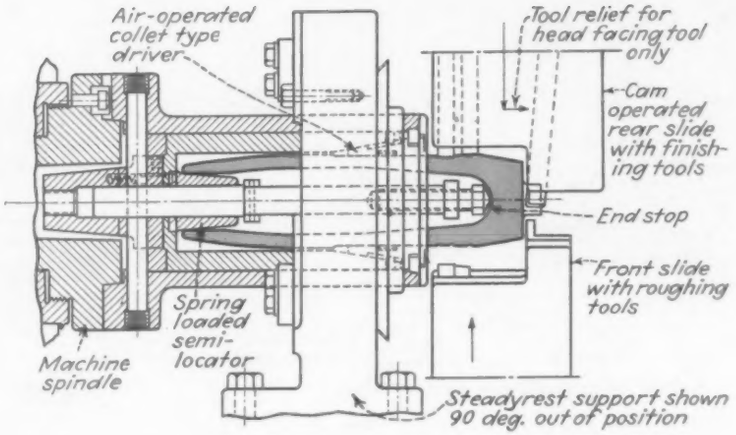

Air-operated collet type driver
Tool relief for head facing tool only
Cam operated rear slide with finishing tools
End stop
Front slide with roughing tools
Spring loaded semi-locator
Machine spindle
Steadyrest support shown 90 deg. out of position

Fig. 102—Stellite tools are used on front and rear slides of the Sundstrand Model 8 automatic lathe set-up for base-end operations on 75-mm. shell

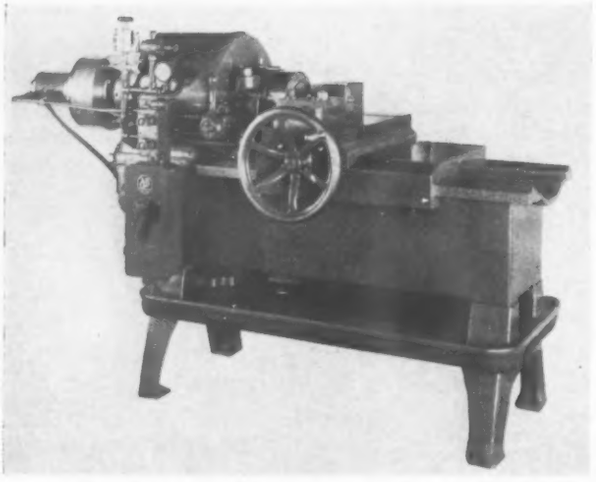


Fig. 103—The Blood shell grooving lathe holds the shell in an air-operated collet chuck when removing the center boss and cutting the band and crimping grooves in 75- and 90-mm. shell

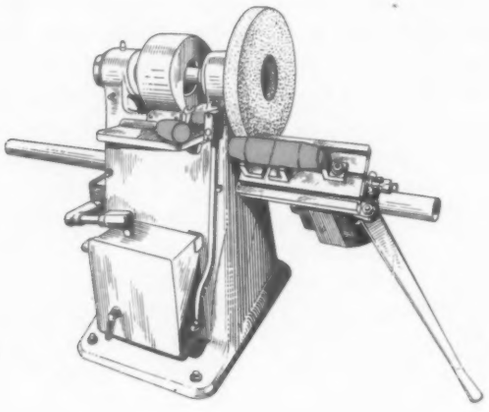


Fig. 104—Base ends of 75- and 90-mm. shell can be ground to proper length in a simple set-up on a disk grinder like the No. 4 Gardner. Simple V-blocks and a stop position the shell

Fig. 106—The Frew base facing machine is arranged automatically to increase spindle speed in steps as facing tools approach the center of the work, thus maintaining a fairly constant cutting speed for the facing tool

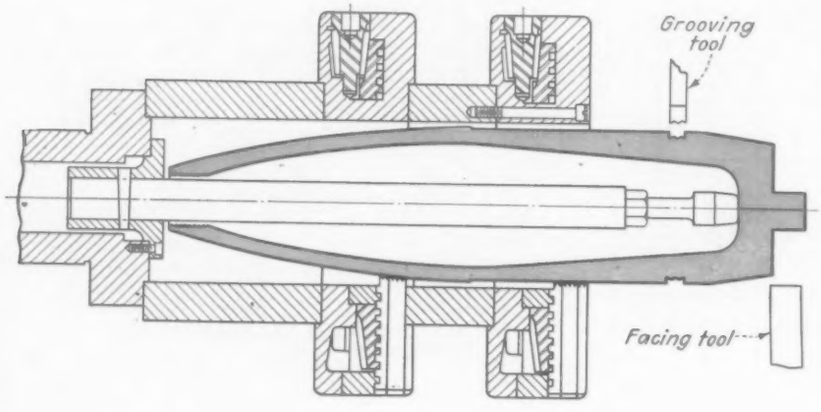


Fig. 105—A double manually-operated chuck holds 155-mm. shell for base end operations on the Sparks-Simplex hydraulic lathe

rear tool post. The nose end of the shell is supported in a spring-loaded cup inside the chuck. A form tool for roughing the band groove is carried in the rear tool post, while the front turret supports a carbide-tipped facing tool for the base end, a cam actuated slide with a form tool for finishing the band groove, and a special toolholder with two carbide-tipped tools for undercutting the sides of the band groove. When the shell has been located in the chuck, the shell is faced for weight correction, then the band groove is roughed out with the carbide-tipped form tool in the rear toolpost. Next, the band groove is finish formed with the carbide-tipped tool in a sliding tool-holder, which is guided by the waving face cam on the chuck. Finally, the sides of the band groove are undercut with a special hand-operated tool on the front turret. This expanding tool carries two carbide-tipped bits. For some 155-mm. shell, the waving and undercutting tools are unnecessary, and only a finish-form tool is used to finish the band groove. With the set-up shown, production is estimated at 3.0 min. per piece, floor-to-floor time, when drive is from a 5-hp. motor.

A standard Sundstrand Model 8 automatic Stub lathe with special tooling is used for cutting off the center boss, facing the end, and forming band and crimping grooves on the base end of 75-mm. shell. The part is held in an air-operated, collet-type driver which has an adjustable end stop to provide for location of the shell from the bottom of the cavity. A spring-loaded cone-type semi-locator registers in the bore of the open end to centralize the shell. A roller type steadyrest supports the outer end of the chuck. As shown in Fig. 102, the front slide of this machine feeds crosswise and carries a parting tool for cutting off the center boss, a tool for roughing out the band groove, and another tool for forming the taper adjacent to the band groove. The rear slide also feeds crosswise and carries three tools. One of these tools faces off the base end, another finish forms the band groove, and the third forms the crimping groove. Tools in the rear slide are positioned so that the facing tool finishes its cut before the two form tools reach the work, and the slide is moved longitudinally $\frac{1}{16}$ in. to provide relief for the facing tool and bring the form tools into proper position.

The machine has an automatic cycle, after the part is loaded, of rapid approach, feed, rapid return and stop, all timed and interlocked with the starting and stopping of the machine spindle and the coolant flow. Operator's position is at the end of the machine, and the control button station is conveniently placed. As a safety measure, the controls are so arranged that the cycle control button will not operate until after the part is properly clamped in the chuck. Using Stellite tools at 120 ft. per min. and a feed of 0.015 in. per rev., floor-to-floor time is 0.92 min. per piece, giving a production per hour of 55 pieces at 85 per cent efficiency. If it is desired to knurl the band groove during this operation, the set-up on the Model 8 Sundstrand automatic lathe is the same as that shown in Fig. 102, except that an over-head tool slide is added to carry the knurling tool. Adding knurling to the set-up increases the floor-to-floor time to 1 min. and the production per hour at 85 per cent efficiency then is 51 pieces. If the knurling is done in a separate operation, an extra operator and a machine for knurling is required.

The Blood type grooving lathe made by W. C. Lipe, Inc., shown in Fig. 103, can be used for cutting the band groove and removing the center boss on 75- and 90-mm. shell with either carbide-dipped or high-speed steel tools. Work is gripped on the outside diameter close to the band groove in an air-operated collet, registering endwise from the finished face of the open end. With tools mounted on the cross slide, the center boss is cut off flush with the closed end and the band and crimping grooves are formed. The operator loads the work in the collet, starts the spindle by means of a pushbutton, feeds the cutting tools to positive stop by hand feed, returns the tool slide to loading position, and stops the spindle ready to unload. The machine is driven by $7\frac{1}{2}$ hp. motor with brake. When using high-speed steel tools, the spindle is rotated at a speed which provides 90 ft. per min. cutting speed. This is increased to 150 ft. per min. when using carbide-tipped tools. Following this operation, the Lipe line-up of operations calls for grinding the base end of the shell using a disk grinder with swinging table as shown in Fig. 104. For this operation, the shell is simply placed in V-blocks on the swinging table of the grinder, and is positioned endwise against the finish faced nose end. With this method a smooth surface can be provided on the base end to insure proper contact of the base cover plate for spot welding.

A 15-hp. motor is used to drive the Sparks-Simplex No. 101-A Hydromatic manufacturing lathe when set up as shown in Fig. 105 for finish facing the base and grooving for the band on 155-mm. shell. A special pot chuck made up of two scroll-operated chucks mounted with spacers on the end of the spindle nose holds the shell which is positioned lengthwise by a stop bar locating at the bottom of the cavity. Properly supported by a steadyrest, this chuck provides a reasonably heavy-duty drive for the shell. Carbide-tipped facing and forming tools are used, each being supported by the front and rear slides of the machine. Production is estimated at 37 shell per hour for the 155-mm. size, more for smaller shell.

Designed especially for heavy cutting when facing

the ends of forged shell bodies, the Frew base facing machine has capacity for shell up to 6-in. diameter. In this machine, shown in Fig. 106, there is a main spindle housing which carries the main spindle bearings, the spindle driving gears and a dovetailed extension at the front for the saddle. A drawback collet is fitted in the front end of the spindle, false jaws being used for the different shell diameters. There is an adjustable stop-rod in the spindle for locating the shell for depth. The tool slide on the saddle has an in-and-out adjustment for setting tools in relation to the shell. It is fed with an hydraulic cylinder. The tool block mounted on this slide holds two tools, one for rough facing and the other for finishing the base end. At the left-hand end of the tool slide is a mechanism which operates a cam switch to provide four speeds to the spindle, progressively accelerating the motor from the lowest to the highest speed as the tools move from the periphery to the center of the shell. When the center is reached, a limit switch disconnects the motor as the tools return to the starting position. A four-speed 15-hp. motor is used. After the operator has started the motor, the cycle is automatic until the spindle is stopped for unloading. Using "Ultra Cobalt" steel for the facing tools, a facing speed of 45 ft. per min. can be maintained fairly well across the base of the shell. Floor-to-floor time on 5-in. shell is 20 per hr. when using this tool steel.

Sometimes it is necessary to weigh the shell after it has been machined on the base end in order to insure that it comes within the weight tolerance allowed on the manufacturing drawing. If the shell is overweight, it usually can be brought to weight by facing more metal off the base end. This is done in a single-purpose machine like that just described. In some cases the end of the shell is scribed to indicate the additional metal to be removed, and in other cases the chips removed are weighed as they drop into a pan from the cutting tool.

Nose Threads Tapped or Milled

Although during the past war practically all shell required threading in the nose or base ends were finished by thread milling, development of ground thread taps and of collapsible taps with ground chasers, which are capable of very accurate work, now makes it possible to tap these shell rapidly and accurately. Ordnance Department drawings for 75-, 90-, 105- and 155-mm. shell all call for the same size thread in the nose end. This is a 2.0-12NS-1 thread having the following dimensions: minimum major diameter, 2.0000 in.; pitch diameter, 1.9459 + 0.0106 in.; minor diameter, 1.9098 + 0.0090 in.

The Landis Machine Company has developed a special Landmaco No. 1½ R shell tapper, Fig. 107, which will handle the tapping of the nose end of all shell from 75-mm. to 155-mm. inclusive. The universal fixture on this machine quickly can be adapted to any one of these sizes of shell by merely interchanging the two work support bushings and the work support block. Basically of the same design as standard Landmaco threading machines, this shell tapper has been engineered to assure maximum accuracy of the finished thread. The fixture comprises a work supporting cradle, a hardened and ground centering bushing to support the nose end of the shell, and a hardened and ground female center at the rear. This center is slidably in alignment with the center of rotation of the machine and is employed both to support the base end of the shell and to provide the gripping or holding action for the work during the threading operation.

The pressure exerted by the pneumatically operated center is sufficient to lock the work rigidly into position for tapping. Both the front bushing and the rear centering bushing are ground accurately to size and are in close alignment with the center of rotation of the machine. In running tests with this machine on shells which were purposely bored 0.050 in. off center, the machine produced threads which were within 0.0025 in. of concentricity with the body of the shell, total indicator reading. Production obtainable from the special shell tapper ranges from 116 shell per hour on the 75-mm. size to 95 shell per hour on the 155-mm. size.

The machine spindle of the Landmaco No. 1½ R shell tapper is equipped with a special Style LT collapsible tap having internal ducts through which coolant is conveyed to the cutting edges of the ground chasers. The tripping collar on this tap also acts as a pilot to assure maintenance of close tolerances for alignment of the thread with the shell body. The collar is ground to a running fit in a pilot bushing located at the front of the fixture in which the shell is centered. This bushing operates in anti-friction bearings to minimize wear. Recommended chaser rake and throat angles for the tap used on shell noses in this machine are given in Fig. 108. The chasers should never be allowed to become dull.

Although shown tapping fuse plug holes in the base of a shell not covered in this article, the Natco horizontal two-spindle tapper shown in Fig. 109 is of interest because of the ruggedness of the 44-in. diameter two-position rotating fixture in which the shell are held. Each position on the fixture locates and clamps two shell for the tapping operation. The reversing motor drive unit has two heavy-duty tapping spindles with individual leadscrews and tap holders. Head is provided with change gears to

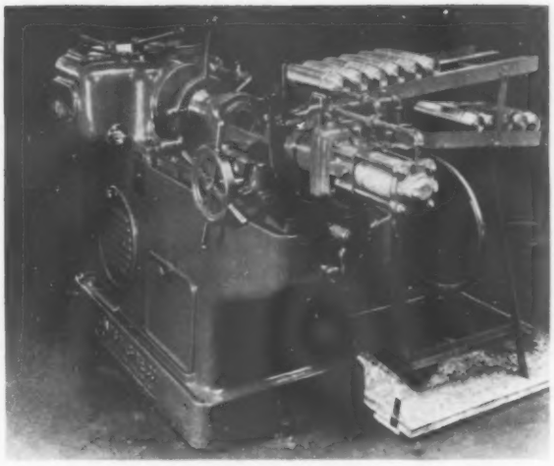


Fig. 107—The specially-designed Landmaco No. 1½ R shell tapper is set-up for 75-, 90-, 105- or 155-mm. high-explosive shell by changing hardened and ground centering bushings at each end of the fixture

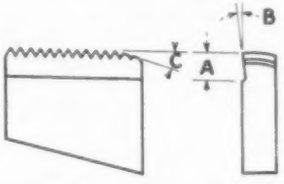


Fig. 108—Chasers for the Style LT tap used in the Landmaco shell tapper should have a $\frac{3}{16}$-in. wide cutting edge A ground at an angle B of 20 deg. Throat angle C should be kept at about 24 degrees

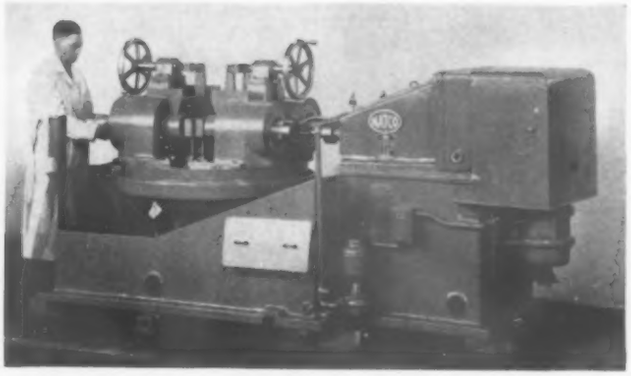


Fig. 109—A 44-in. diameter fixture on this Natco shell tapper presents two shells to the tapping spindles while two holding chucks are being unloaded and reloaded at the other side

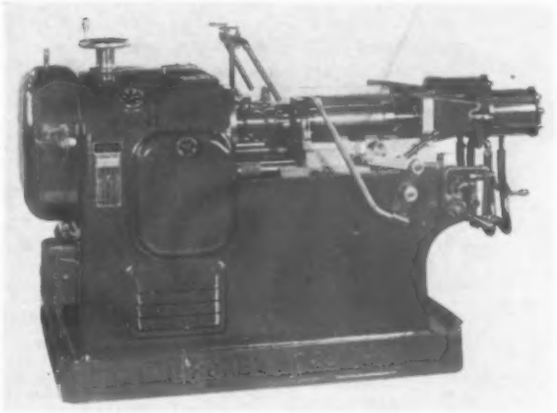
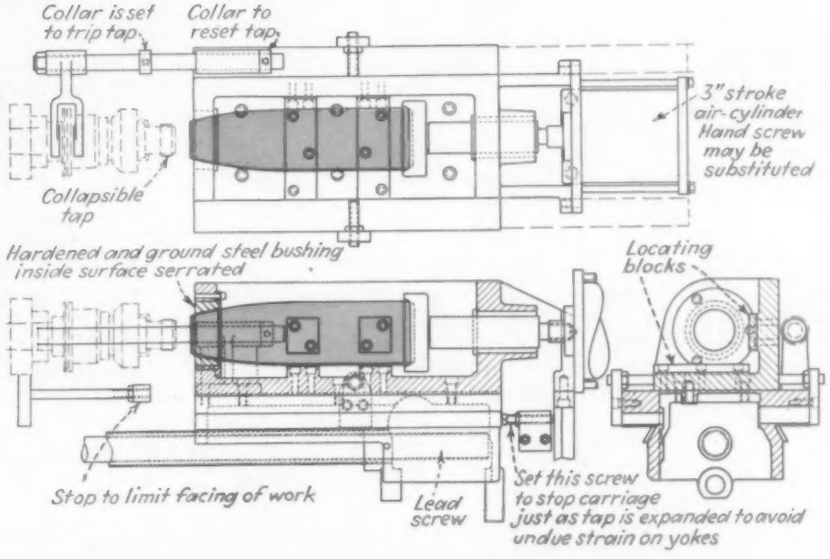


Fig. 110—Tapping and chamfering of the nose end are combined in a series of Murchey shell tappers designed for high-explosive shell. Fixtures are air-operated

Fig. 112—Thread millers frequently are used for cutting the thread in the nose ends of high-explosive shell. One man operates two machines

Fig. 111—An air cylinder forces a female center against the base end of the shell to move it forward into a serrated bushing, which centers the nose end for threading with Murchey collapsible taps


Collar is set to trip tap
Collar to reset tap
3" stroke air-cylinder
Hand screw may be substituted
Collapsible tap
Hardened and ground steel bushing inside surface serrated
Locating blocks
Stop to limit facing of work
Lead screw
Set this screw to stop carriage just as tap is expanded to avoid undue strain on yokes

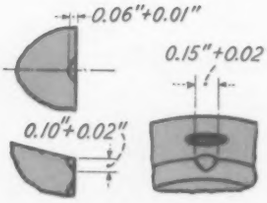


Fig. 113—Five staking notches are spaced 72 deg. apart on the nose end of the 75-, 90- and 105-mm. and the 3-in. anti-aircraft shell. Dimensions of these notches are given above

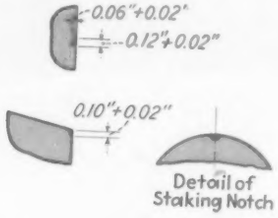


Fig. 114—Only one staking notch is specified for the nose end of the 155-mm. high exposive shell. It can be cut with a hand broaching tool

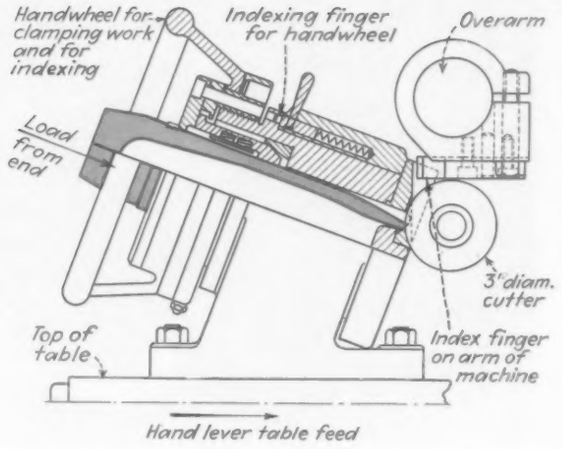


Fig. 115—This Sundstrand manually-operated, five-position fixture holds the 75-mm. shell for milling of staking notches. Handwheel serves both for clamping the shell and for rotating the collet chuck when indexing

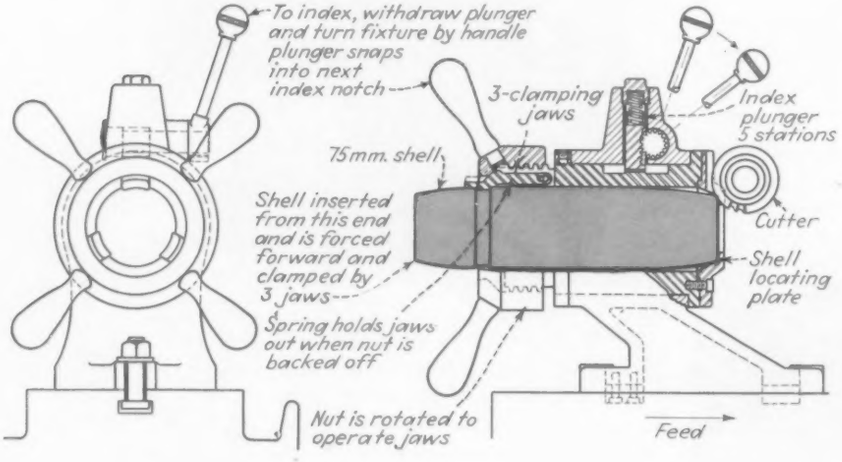

To index, withdraw plunger and turn fixture by handle plunger snaps into next index notch
3-clamping jaws
Index plunger 5 stations
75mm. shell
Shell inserted from this end and is forced forward and clamped by 3 jaws
Cutter
Shell locating plate
Spring holds jaws out when nut is backed off
Nut is rotated to operate jaws
Feed

Fig. 116—The 75-mm. shell is held horizontally in the indexing fixture used on a Van Norman hand miller for milling the staking notches

Fig. 117—Shell for 37- to 155-mm. in size can be marked quickly with the lot number, year of manufacture, manufacturer's initials or symbol, and shell caliber and designation on this hand-operated numbering machine

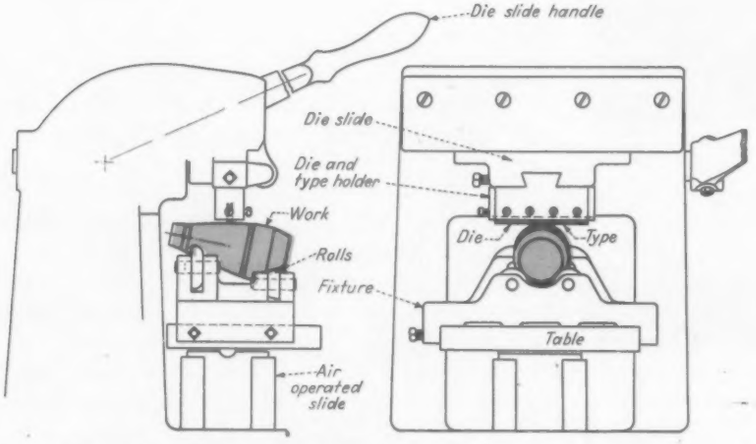
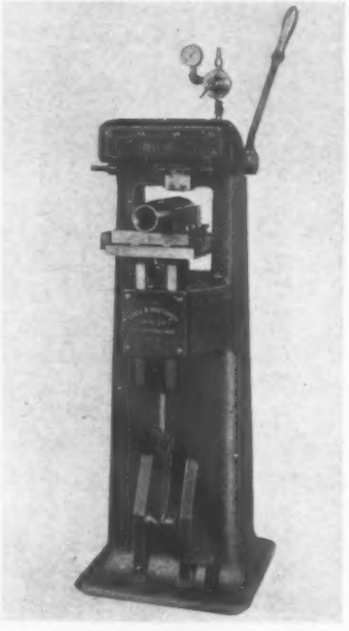


Fig. 118—This cradle fixture on a Noble & Westbrook marking machine is designed for 60-mm. high-explosive mortar shell. Similar fixtures are used for other shell where length of marking is more than 2½ in. Work is pressed against dies by foot pedal



alter spindle speeds as required, and the leadscrew nuts have compensating mechanisms to take up the wear as it may occur.

A series of single and double spindle machines designed especially for tapping and chamfering the nose ends of high explosive shell was announced several months ago by the Murchey Machine & Tool Company. One of the two-spindle units arranged to tap and chamfer 4.5-in. high explosive shell is shown in Fig. 110. The machine spindles are equipped with Murchey Type M hardened and ground collapsible taps and also carry four reaming tools. The taps are actuated by yokes which work between adjustable stops to trip at a predetermined thread length, and reset the taps on the return stroke.

Sequence of operations on these Murchey shell tappers is to chamfer with the taps collapsed and with leadscrews disengaged. The carriages then are returned and the taps automatically are expanded for the tapping operation. Next the leadscrews are engaged and the shell tapped with accurate lead at a cutting speed of 20 ft. per min.

In Fig. 111 are shown some of the details of the fixtures which position and hold shell while chamfering and tapping in a Murchey machine. Hardened and ground locating pads hold the shell within a few thousandths of alignment with the spindle, then it is picked up by the air actuated female center at the back end of the fixture and moved forward until the nose end is firmly held in a hardened and ground serrated bushing. Locating pads, female center, nose end bushing and stroke of air cylinder can be changed to accommodate shell of different contour or size.

Some shell producers consider it better to mill the threads in the nose of the shell, rather than to use collapsible taps. The contention is that over a period of time enough saving tap cost and scrap losses will be realized to warrant the use of a thread miller for this operation. Both methods will produce acceptable threads, when using modern equipment, and the selection of method must be based on personal preference, availability of equipment, and relative cost per piece of the threading operation over a reasonable length of time. There are a number of makes of thread millers adaptable for nose-end threading of shell. Of these a number of contractors have made use of the Hall Planetary miller, as shown in Fig. 112. In these machines the work is held stationary in a fixture, often air operated, and the thread is finished in a little more than one revolution of the cutter head.

Hand Millers Used for Notching

In Figs. 2, 113 and 114 are shown details of the staking notches milled in the nose ends of 75-, 90-, 105- and 155-mm. shell. The milling of these notches customarily is done on a small hand milling machine which has a manually-operated indexing fixture. Similar fixtures can be mounted on the table of almost any hand miller of suitable capacity. Such machines are made by Kent-Owens Machine Company, Producto Machine Company, Sundstrand Machine Tool Company, and Van Norman Machine Tool Company, among others.

The fixture used on the No. 00 Sundstrand "Handmil" locates the shell against the face of the open end, and on a plug which registers in the bore, as indicated in Fig. 115. This fixture is provided with a handwheel for clamping the work. Forward movement of the indexing plug permits rotation of the fixture for manual indexing so that the five notches can be milled with but one clamping of the part. An adjustable positive stop limits travel of the table and governs the depth of the notch. A safety finger attached to the machine arm engages a notch in the fixture so that the fixture cannot be indexed during a cutting cycle. Using a 3-in. diameter high-speed steel cutter at 80 ft. per min. cutting speed, production per hour is 100 to 150 pieces.

A similar horizontal fixture, Fig. 116, is used on the Van Norman No. 2M "Handmill" for notching 75-mm. shell at a speed of 100 shell per hour. Hand feed is more rapid than power feed on this operation. Only a short stroke is required, and more time is consumed in indexing, and in loading and unloading the fixture, than in actually cutting the notches. Because of the weight of the larger shell, some contractors may prefer to broach these staking notches, using a hand tool like that made by R. P. Frye of Chicago. This is especially true in the case of the 155-mm. shell, which has only one notch.

Identification Stamping Quickly Done

Ordnance Department drawings for 75-, 90-, 105- and 155-mm. shell specify that each shell is to have stamped on the circumference of the body, 0.25 in. forward of the rotating band seat, with $\frac{1}{8}$ in. letters and figures, the lot number, year of manufacture, initials or symbol of manufacturer, caliber and designation of the shell. Often the stamping machine will be set up to mark everything except the lot number, which is filled in by hand later. In most production lines, however, the marking machine has interchangeable type and the type for the lot number is changed when necessary.

There are several methods by which the stamping can be done. In some instances the type die can be set up in a punch press. Usually, however, a standard marking machine of one type or another is used. One of the most popular types is a simple, hand-

operated unit like the No. 4 Noble & Westbrook stamping machine shown in Fig. 117. Equipped with a flat anvil, as shown, identification markings up to 2½ in. long can be stamped on the body of the shell. In this machine, the die slide is above the work, and the type holder is arranged to take engraved dies, carrying several letters, numbers or symbols, as well as individual pieces of type. The work is held up against the die by pressure on a pedal and the slide is traversed across the work by hand. Where the marking length is more than 2½ in. a cradle fixture, like that shown in Fig. 118, is used. This drawing also shows the principal parts of the machine, the die holder and the cradle.

The power-operated Noble & Westbrook marking machine shown in Fig. 119 will mark 75-, 90-, and 105-mm. shell at the rate of 8 per min., when operated by one man, or 12 to 15 per min. with two men. On this machine the loading dial rotates at about 6 r.p.m., while the pressure dial rotates at twice that speed. Both are driven by a ½ hp. motor when there is only one line of marking. Where there are two or three lines to be stamped, a ¾ hp. motor is used. A pressure of 1,000 to 4,000 lb. holds the marking dies against the work as it passes between the dies and the pressure dial. Only one shell can be put through at a time, as any variation in diameter between two shell going through at once would result in uneven marking on the smaller shell. While this unit has not as yet been applied for marking 155-mm. shell, it has capacity to make the necessary impressions, and its use is recommended where production quantities justify. On some shell it is necessary to mark the identification on the copper band. In these cases a burnishing platen must be added after the marking dies so as to smooth down the band.

Developed originally for marking identification symbols on steel cylinders, the power-operated marking machine shown in Fig. 120 would seem to have possibilities where shell are to be made in large quantities. Here, the die is held down against the work by air pressure, while the work is carried under the dies by a pressure disk driven by a ½ hp. motor. The "paddle wheel" shown on the same shaft as the pressure disk serves to keep the work separated, in order that only one piece may pass under the dies at a time, and rotates because of pressure from the piece being carried under the die. Not only is production of stamped parts rapid with this unit, but it is possible to feed it directly from a conveyor line with but little attention from the operator.

Some shell require the stamping of identification markings on the base, instead of on the cylindrical body. Where this is the case, the marking dies or type easily can be set up in a press, with the shell placed nose down in a suitable fixture on the lower platen. As there may be a slight variation in the length of these shell, an hydraulic press will be more satisfactory than a mechanical press for this operation. As the hydraulic press can be set to apply a predetermined pressure, rather than move to a predetermined point, the indentation will be more uniform.

Band Grooves Knurled In Most Cases

As shown in Fig. 94, the annular grooves in the band groove must be knurled or notched before the band is applied. This is to prevent rotation of the band on the shell when the gun is fired. Several methods have been used for notching these annular grooves, including the knurling set-up on machines doing other operations as previously discussed. On some of these shell, where the longitudinal grooves or scores are spaced far apart it may be best to perform this operation in a punch press, producing one score for each stroke of the press and indexing the shell in a suitable fixture between strokes.

However, where the scores are close enough together to permit machine knurling, it is more economical to use a knurling roll. Probably the best known units for knurling these band grooves are the shell knurling machines built by Morley Machinery Corporation. Several sizes of these machines have been developed for the various sizes of shell. Principal features are essentially the same for the different sizes, and are shown in outline in Fig. 121. A side view is shown at *A*, while a top view which indicates the arrangement of the pressure and knurl rolls in relation to the shell body is shown at *B*. The machine for 75-mm. shell and that for the 3-in. anti-aircraft shell is arranged with a hole in the top plate so that the shell can be dropped into position between the pressure rolls and the knurled rolls. Larger sizes of these machines are cut away on one side so that the shell does not have to be lifted, but can be pushed into position between the rolls and the knurl. In each case the closed end of the shell is rested on a revolving plate and two hardened pressure rolls are moved horizontally by a linkage connected to an air cylinder to force the shell against the revolving knurl. When set up on the production line, the knurling tool is rotated continuously and the operator positions a shell in the machine, permits it to make ten or twelve revolutions and removes it to the conveyor line. Floor-to-floor time is estimated at 4 to 5 sec. for the 75-mm. shell, 6 to 8 sec. for the 3-in. anti-aircraft shell, 8 to 12 sec. for the 90- or 105-mm. shell, and 10 to 12 sec. for the 155-mm. shell.

An important part of the shell, the driving band is forced into the rifled grooves of the gun when the

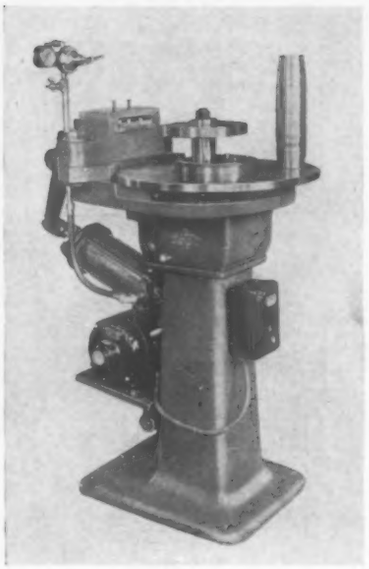
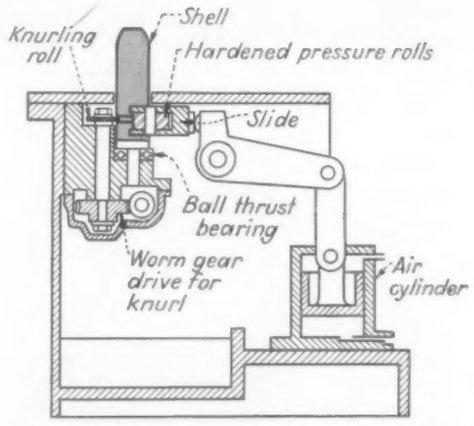


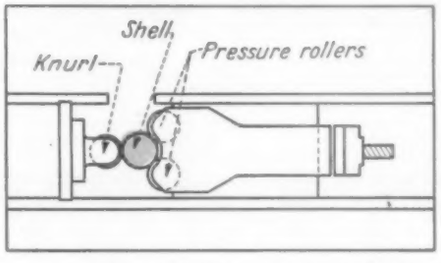
Fig. 119—Shell can be marked twice as fast with this power-operated machine as with the hand-operated unit shown in Fig. 117. Pressure of dies against work is adjustable between 1,000 and 4,000 pounds total pressure

Fig. 120—Developed for marking steel cylinders, this Noble & Westbrook machine easily can be adapted for marking 75- to 155-mm. shell of all types



A- Side View Showing Drive for Knurl

Fig. 121—Longitudinal grooves or scores in the band seat are cut across the annular grooves, produced in a previous operation, to form a right-angle knurled pattern with the Morley shell knurling machine. Usually about ten revolutions of the work are necessary



B- Top View Showing Rolls and Knurl

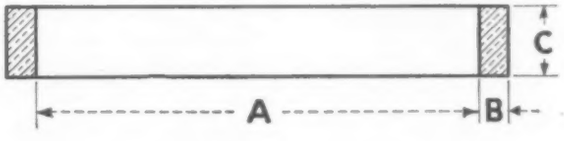


Table VII—ROTATING BAND BLANKS FOR HIGH-EXPLOSIVE SHELL

Shell Size	*Mark*	*Type*	*Inside Diameter Dimension A Inches*	*Wall Thickness Dimension B Inches*	*Band Width Dimension C Inches*
75 mm.....	M48	Field Gun	2.957−0.020	0.18 ±0.01	0.47−0.01
3 in.....	M42	A.A. Gun	2.995−0.010	0.22 ±0.01	1.00−0.01
90 mm.....	M58	A.A. Gun	3.56 −0.010	0.23 ±0.01	1.17−0.01
105 mm.....	M1	Howitzer	4.16 −0.02	0.205±0.012	0.79−0.01
155 mm.....	M101	Howitzer	6.12 −0.05	0.320±0.014	1.97−0.02
155 mm.....	M102	Gun & How.	6.10 −0.05	0.280±0.014	0.58−0.02

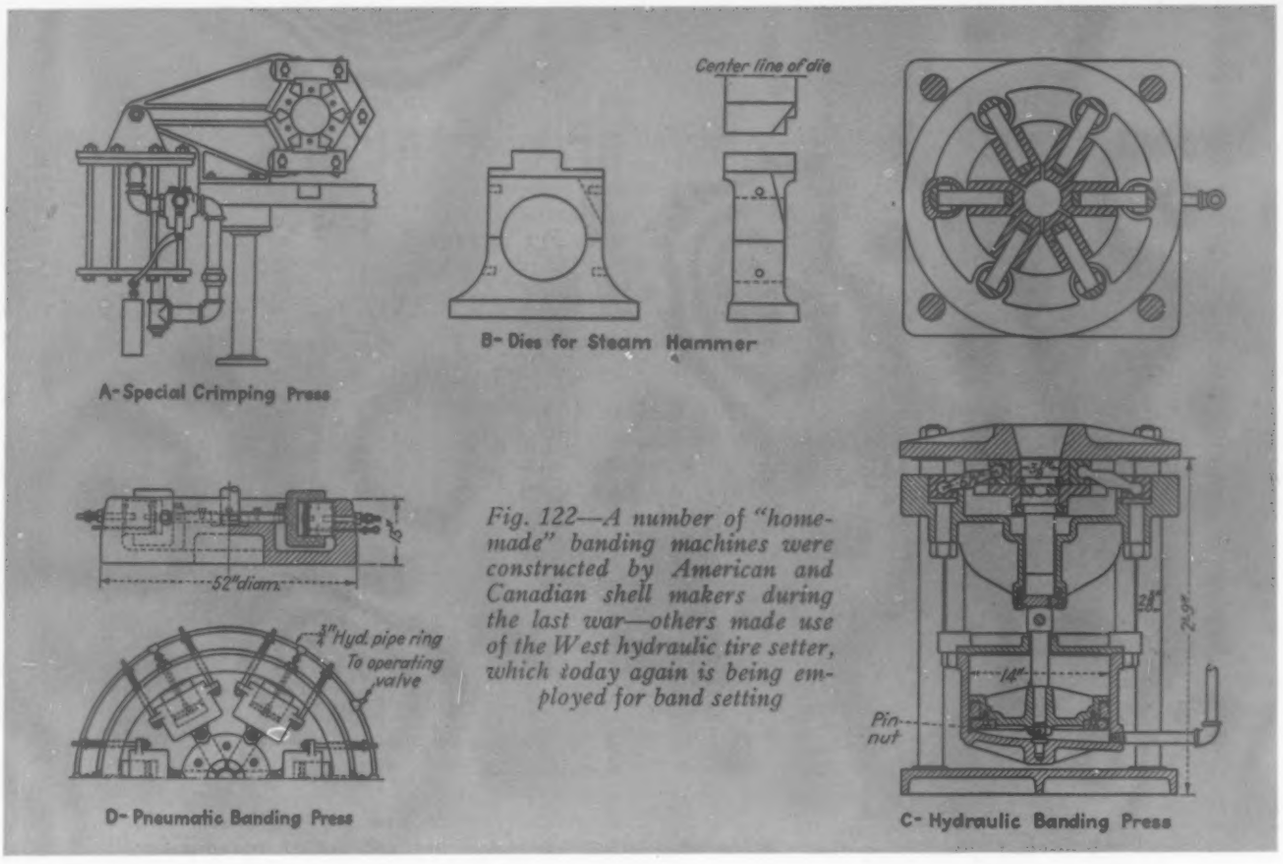


Fig. 122—A number of "home-made" banding machines were constructed by American and Canadian shell makers during the last war—others made use of the West hydraulic tire setter, which today again is being employed for band setting

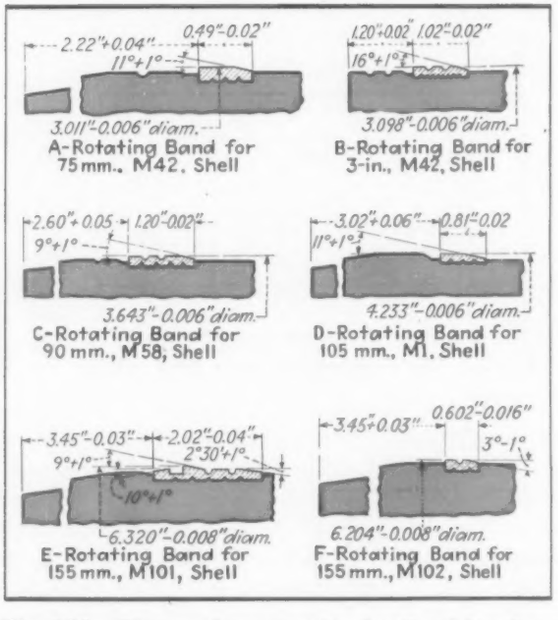


Fig. 123—Shown above are the details of bands as finish turned on 75-, 90-, 105- and 155-mm. high-explosive shell used by the U. S. Army. These bands are for the shell shown in Fig. 2. Band turning is a high-speed operation for which a number of tool set-ups are satisfactory

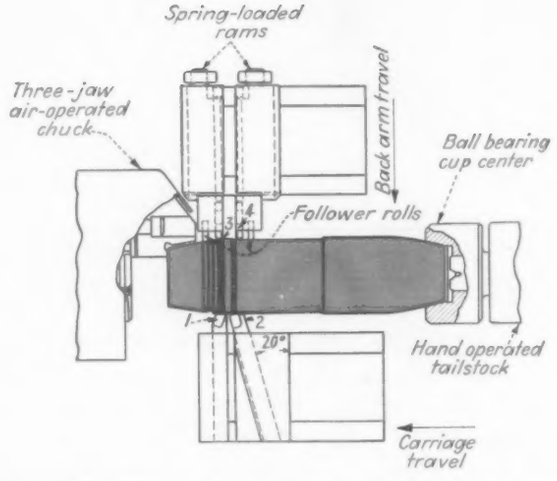
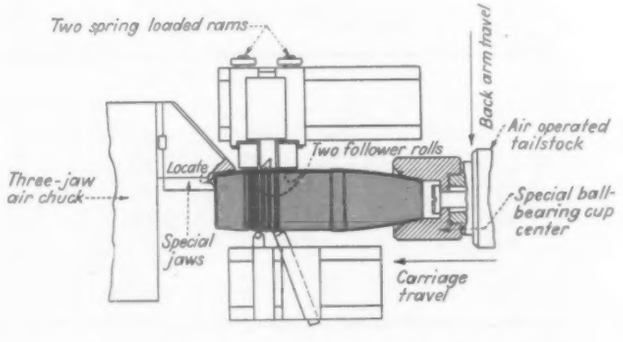


Fig. 124—The tooling set-ups for turning the band on 75- and 105-mm. high-explosive shell in Fay automatic lathes are similar. Carbide-tipped tools are used in all cases

Fig. 125—A form tool is added to the set-up shown in Fig. 124 when turning the band on 90-mm. shell in the Fay lathe



shell is fired and so causes the shell to rotate as it travels through the barrel. This band imparts spin to the shell in such a short interval of time that the strain on it is enormous. There must be no possibility of it turning on the shell. This is the reason why the annular grooves on some shell are waved, and on others are notched or knurled. Rotating bands for 75- to 155-mm. shell used by the U. S. Army are made of gilding metal (approximately 95 per cent copper and 5 per cent zinc) and are cold pressed into position. Some larger shell use copper bands, and most larger shell require heating of the band before it is applied. These bands are cut from tubing to dimensions shown in Table VII, and sometimes must be straightened by forcing over a mandrel before application to the shell body. The band is slipped over the shell and located at the band seat. Sometimes they are held in place when putting them in the press by striking with a hammer after being placed in the groove.

The West hydraulic shell banding machine now widely used for banding shell has six dies which force the band into place. Frankford Arsenal practice is to apply a gage pressure of 900 lb. to the band with this machine, then release the pressure and rotate the shell about 15 deg. Then pressure again is applied for the same amount of time, approximately 3.2 sec. This cycle is repeated two or three times to insure that the band has completely filled the groove. Occasionally a band is removed for inspection to make certain that the metal is flowing properly.

During the last war, American and Canadian shell makers developed a number of special banding machines for this operation; four of these units are shown in Fig. 122. The pneumatic crimping press shown at *A* was designed and constructed at the Canadian Ingersoll-Rand shops for banding 18-lb. British shrapnel. This machine was easy to use, as the shell did not have to be held at arm's length when positioning it between the dies. The dies were actuated by toggles connected with a lever arm operated by a compressed-air piston. The 18-lb. British shrapnel of that period was a little more than 3¼ in. outside diameter, and two operators working at one of these machines were able to band about 30 shell per hour. The machine had a speed of 30 strokes per min., about ten strokes being necessary for the operation. Shell was turned slightly between each stroke.

Another pneumatic banding machine constructed by a contractor for 18-lb. British shrapnel is shown at *D*, in Fig. 122. This machine was operated at the regular shop air pressure of 100 lb. per sq.in. Pressure was transmitted by means of toggles through the vertical rod to thrust blocks which forced six steel jaws against the copper band, compressing it into the band groove from all sides. This press acted rapidly, and five or six strokes were usually employed, turning the shell slightly each time. One man and a boy could band 1,400 shell in twelve hours.

One shop making 12-in. Russian shrapnel during the last war employed dies like those shown at *B* in Fig. 122 for compressing the band on the shell. These dies were used in a steam hammer. With the shell in position, the upper die was fed down until the copper band had been compressed firmly into the band groove. Three men were employed in the groove banding shell at this plant. One operated the crane that supported the shell, another operated the hammer, and the other turned the shell in the dies between hammer strokes. A leather cover was slipped over the shell to protect the turned surfaces from the sling used to support the shell during this operation.

A special hydraulic banding press used by the Canadian Allis-Chalmers Company during the last war for banding 4.5 in. British high explosive shell is shown at *C* in Fig. 122. This press consisted of a ring-like cast steel body inclosing six stationary pistons. Mounted on each piston was a movable cylinder having a lug on its forward end. Connected at each lug and guided by a central hub through which they passed were six banding punches. These punches were pressed forward against the copper band by water under 1,500 lb. per sq.in. pressure entering the cylinders from the supply pipe encircling the pressed body. The punches were withdrawn by heavy springs. Operating valve was controlled by one lever, admitting the water under pressure in one position and in another shutting off the supply and opening the discharge to the supply tank. Two men operated one banding press, their output being about 45 banded shell per hour.

Rotating Bands Turned at High Speed

After the bands have been pressed into place, the shell are delivered to a band turning lathe. Here the bands are form turned and faced at each end at high cutting speeds. Details of bands used on certain 75-, 90-, 105- and 155-mm. high explosive shell by the U. S. Army are shown in Fig. 123. These bands are made from gilding metal, and must be turned to close limits, as it is the band and the bourrelet that support the shell in the gun barrel.

Set-ups on Fay automatic lathes recommended by Jones & Lamson Machine Company for turning the band on the 75-, 90- and 105-mm. shell are quite similar, 8 × 21 in. lathes being used for the 75-mm. size and 12 × 33 in. lathes for the 90- and 105-mm. shell. The 75- and 105-mm. shell require a tooling

TOOLING SET-UPS FOR HIGH EXPLOSIVE SHELL

set-up like that shown in Fig. 124. Carbide-tipped tools are used, two being mounted on the front carriage while the other two are mounted in spring-loaded rams on the back arm. Tool 1 turns the outside diameter of the band while tool 2 forms the taper on the front of the band. The two tools on the back arm are fed in to face both sides of the band down to the shell body. The spring-loaded rams carrying these tools have follower rolls which bear against the body and prevent the tools from cutting into the steel shell. These follower rolls reduce tool breakage and should be used where only semi-skilled operators are available. A similar set-up is used for the 90-mm. shell, as shown in Fig. 125. This shell requires grooving of the band, so a form tool is mounted on the back arm to perform this operation while the two facing tools are making their cut.

In the Fay automatic lathe set-ups for 75-, 90- and 105-mm. shell, the finish turned shell body is held in a three-jaw, air-operated chuck on the base end, special jaws being used to locate the shell endwise. The nose end of the shell is supported by a special ball bearing center on the tailstock. A hand-operated tailstock is used for the 8×21 in. lathe, but air-operated tailstocks are used on the larger sizes. For the 75-mm. shell, the spindle speed is 810 r.p.m., giving a cutting speed of 640 ft. per min. With a feed of 0.008 in. per rev., it is estimated that hourly production will be 133 shell.

When turning the band on the 90-mm. shell in a 12×33 in. Fay lathe, the spindle speed recommended is 606 r.p.m., giving a cutting speed of 593 ft. per min. Feed used is 0.023 in. per rev. and estimated production is 107 shell per hour for each machine. The 105-mm. shell also is turned at 606 r.p.m. for this operation, giving a cutting speed of 700 ft. per min. Using the same feed, estimated hourly production is 117 shell. A 15-hp. motor is recommended for the 12×33 in. Fay lathe.

The tooling set-up on a 20×27 in. Fay automatic lathe for turning the band on a 155-mm., M-101, high explosive shell involves more tool holders, as indicated in Fig. 126, than did the set-ups for smaller shell on the same size of lathe. For this shell, the carbide tipped tool on the carriage rough profile turns the band at 327 r.p.m., giving a cutting speed of 540 ft. per min., with a feed of 0.018 in. per rev. After this cut has been completed the back arm swings forward and forms the grooves and the taper on the band. The auxiliary slide carrying the skiving tool then finish forms the band and the operator trims the band with hand tools mounted on the front carriage above the rough turning tool. For these operations the spindle speed is held at 327 r.p.m. and the back arm forms with a feed of 0.003 in. per rev.

The tooling layout in Fig. 127 for turning the band on 75-mm. shell in a No. 5 Warner & Swasey universal turret lathe is designed so that it will turn the rotating band to size in one pass from the hexagon turret, and then straddle face and form the taper portion of the band from the rear station of the cross slide. A carbide-tipped tool is used for the turning operation from the hexagon turret, while a high-speed steel tool is used on the cross slide turret. A limit switch has been fitted to the cross slide so as to reduce the speed of the driving motor for the forming operation. Thus, the motor runs on the high side for turning, and as the forming cutter is advanced to the cutting position the limit switch trips for the low speed range. As the forming operation is being completed the automatic dial stop drops into position, thus setting the stops and size without any attention from the operator. The air-operated collet chuck used for this operation is similar to that used on Warner & Swasey set-ups for the base end operations.

The fifth and concluding section of this series discussing various methods used for machining high explosive shell will appear in an early issue.

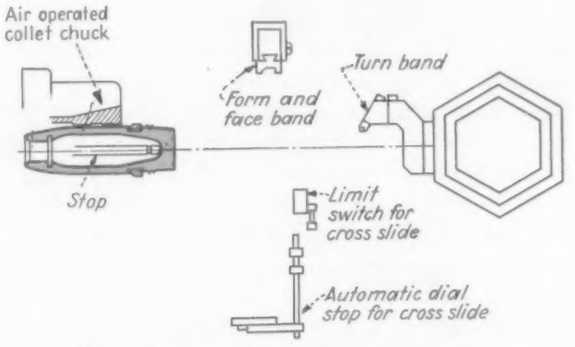
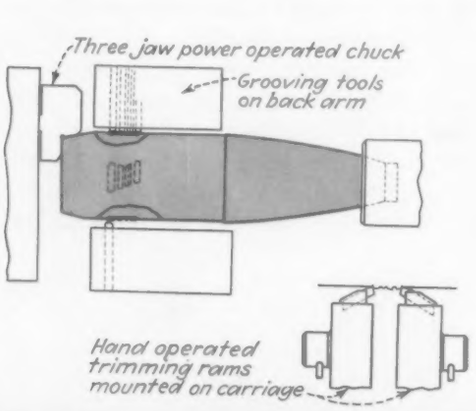


Fig. 127—A No. 5 universal turret lathe is recommended by Warner & Swasey for turning the rotating band on 75-mm. high-explosive shell



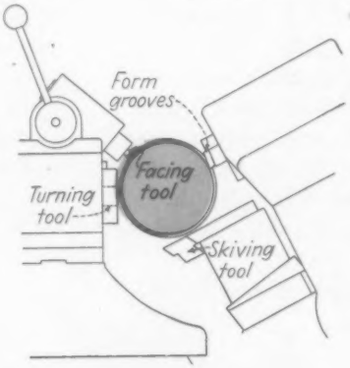


Fig. 126—A 20 hp. motor drives the 20 × 37 in. Fay automatic lathe used for turning the band on 155-mm., M-101, high-explosive shell bodies with this tooling. Production is 34 shell per hour

The Working of TOOL AND DIE STEELS

TOOL STEELS, by their nature, are quality steels containing either a high percentage of carbon or a high alloy content, or a combination of both. In general, they can be classified into five groups: (1) Carbon and low-alloy, (2) oil- and water-hardening, (3) shock-resisting, (4) hot-work, and (5) high-speed steels. This classification is based partly on composition and partly on physical characteristics, and excludes special types, such as high-finishing steel. Furthermore, tool steels can be classified according to use: (1) General-purpose, in which distortion during hardening is relatively unimportant; this type includes carbon, low-alloyed, water-hardening, and oil- or water-hardening steels. (2) Steels for tools and dies in which distortion must be held to a minimum. (3) High-speed and hot-work steels, in which resistance to high temperatures is important.

Composite analyses of steels classified in the latter way are given in Table 1, which also includes the general characteristics of typical types of steels in each group. Table 2 gives general chemical analyses of 50 tool and die steels most commonly used.

Carbon tool steel is the original and simplest type. Alloys are added for the four following reasons:

1. To secure deeper hardness for cutting or wear resistance.
2. To secure greater toughness or strength.
3. To make the steel hold its size and shape accurately during hardening, or to make the hardening operation safer.
4. To give the steel "red hardness," or the ability to do its work when the tool is heated so hot that a plain carbon or low-alloyed steel would soften.

ALLOYING ELEMENTS

Carbon—The function of carbon is to make steel harder and more wear-resisting. As carbon is added, the steel's capacity to harden is increased until about 0.85 per cent carbon is reached, whereupon it will become file hard when quenched. Adding more carbon than 0.85 per cent does not materially increase the hardness, but it does increase wear resistance.

Manganese—Manganese makes the steel sound when it is first cast in the ingot. It makes the steel easier to hot or cold forge. All the steels will contain at least 0.20 per cent manganese, but must be present up to 0.50–2.00 per cent before it is regarded as a special alloying addition. The effect of adding more manganese to carbon steel is to increase the penetration of hardness. Also, manganese causes the steel to harden rapidly; therefore, steels with high manganese should be oil quenched rather than water quenched.

Silicon—All tool steels contain small percentages of silicon, usually from 0.10 to 0.30 per cent, which is added as a deoxidizer and to make them easier to hot forge or roll. With molybdenum, manganese or chromium, high silicon increase the strength and toughness of shock tools. For alloying purposes, silicon may be between 0.50 and 2.25 per cent. When forging and hardening high-silicon steels, care should be exercised because they may decarbonize.

Chromium—Chromium in tool steels increases hardening characteristics, and when present in high percentages confers oil hardening properties to the steel. It contributes wear resistance and toughness, the former of which is not necessarily accompanied by greater hardness. Low- and medium-chromium steels, which are water-hardening, will frequently change size even more than plain carbon types. Chromium also raises the temperature necessary for hardening. In general, for all steels, chromium increases hardenability and hardness depth.

Tungsten—Tungsten must be added to tool steels in fairly large quantities to be effective. Additions up to 1.50 per cent increase wear resistance. Addition of 6 per cent tungsten to 1.30 per cent carbon steel makes it very hard and difficult to grind; this is as much tungsten as is ordinarily used in combination with carbon alone. Such carbon-tungsten steels have no increased hardness penetration and they decarburize slightly more than plain carbon steel. When tungsten range is 12–20 per cent, in conjunction with chromium, it creates red-hardness properties.

Vanadium—Small percentages of vanadium are added to straight carbon

This section was made possible through the cooperation of the following companies:

Abrasive Company
Allegheny Ludlum Steel Corporation
American Society for Metals
Atlas Steels Limited
Bethlehem Steel Company
Braeburn Alloy Steel Corporation
Carboloy Company, Incorporated
The Carpenter Steel Company
Cleveland Twist Drill Company
Columbia Tool Steel Company
Continental Machines, Incorporated
Crucible Steel Company of America
Darwin & Milner, Incorporated
Driver-Harris Company
Eastern Machine Screw Corporation
A. Finkl & Sons Company
Faitoute Iron and Steel Company
Firth-Sterling Steel Company
The Geometric Tool Company
George Gorton Machine Company
Greenfield Tap & Die Corporation
C. I. Hayes, Incorporated
E. F. Houghton & Company
Jessop Steel Company
Lacy Manufacturing Company
Latrobe Electric Steel Company
Lindberg Steel Treating Company
McKenna Metals Company
The Midvale Company
The Moore Special Tool Company
Morse Twist Drill & Machine Company
Norton Company
National Twist Drill & Tool Company
Joseph T. Ryerson & Son, Incorporated
Simonds Saw & Steel Company
Socony-Vacuum Oil Company, Incorporated
The Texas Company
Timken Roller Bearing Company, Steel and Tube Division
Vanadium Alloys Steel Company
Vascoloy-Ramet Corporation

Table 1—GENERAL CLASSIFICATION AND COMPOSITE ANALYSES

Group	Type	Chemical composition						
		Carbon	Manganese	Silicon	Tungsten	Chromium	Vanadium	Molybdenum
	General purpose:							
	A Straight carbon, water-hardening	0.70–1.50	0.15–0.35	0.15–0.35	.....	.....	.....	.....
I	*B Low-alloyed, water-hardening	0.55–1.50	0.15–0.35	0.15–0.50	0.00–6.25	0.00–1.80	0.00–0.50	0.00–0.50
	C Low-alloyed, water or oil hardening	0.45–1.30	0.15–1.00	0.15–2.25	0.00–2.50	0.00–1.50	0.00–0.50	0.00–0.60
	Intricate designs:							
	D High-carbon, high-chrome	0.90–2.50	0.15–1.20	0.15–1.00	0.00–2.00	4.50–14.00	0.00–1.25	0.00–1.25
II	E Oil hardening non-deforming	0.80–1.30	0.35–1.80 1.00–2.00**	0.15–0.50	0.00–2.50	0.35–1.00 0.90–2.00**	0.00–0.50	0.00–0.75
	F Air-hardening non-deforming**	0.80–1.10	0.25–1.00	0.15–0.50	0.70–1.10	4.50–6.50	0.35–1.10	0.40–2.15
	G Tough alloy, punch and chisel types	0.40–0.90	0.15–1.60	0.15–2.50	0.00–3.00	0.00–2.00	0.00–0.60	0.00–2.00
	High-speed and hot-work types:							
	H Cobalt high-speed	0.50–0.90	0.15–0.50	0.15–0.35	2.00–21.00	3.75–5.00	0.50–2.50	2.00–10.00
III	I Standard high-speed	0.45–1.30	0.15–0.75	0.15–0.30	0.00–23.00	3.50–4.75	0.50–2.50	0.00–9.00
	J Hot-work	0.25–1.00	0.15–1.25	0.15–1.50	0.00–19.00	0.50–7.50	0.00–1.25	0.00–1.75

NOTES: This general classification of tool and die steels by chemical composition can be used in conjunction with Fig. 1 for selecting type steels for various uses. The numerical notes which follow indicate changes in physical characteristics due to variation in carbon and alloying elements. Narrower limits of chemical composition for the steels falling in these three groups are given in Table 2.

These group numbers and letters refer only to this article and are not to be assumed as specific types or grades sold by the steel manufacturers.

*Includes tungsten-finishing water-hardening type (1.25–1.50C; 2.50–6.00W; 1.80max.Cr; 0.50 max.Mo), and high-silicon types (0.45–0.75C; 0.35–1.00Mn; 0.75–2.25Si; 0.60max.Cr and Mo).

**Air-hardening types may be high in manganese and low in chrome, or low in manganese and high in chrome, as noted.

NOTES:

1. Wear resistance increases and toughness decreases as carbon content increases.
2. Wear resistance increases and toughness decreases as tungsten content increases.
3. Hardenability increases, wear resistance increases, toughness decreases, movement in hardening decreases, and tendency for soft spots in hardening decreases as chromium content increases.
4. Some special applications (silverware striking dies, certain header dies, etc.) may occasionally require extra penetration of hardness, which may be produced by adjusting manganese and silicon, and controlling melt practice.
5. Hardenability increases, wear resistance increases and toughness decreases as total alloy content increases.
6. Machining difficulties increase as total alloy content increases.
7. Red hardness properties increase and toughness decreases as cobalt content increases.
8. Red hardness properties increase and toughness decreases as total alloy content increases.
9. Water cooling surface in operation, particularly when intermittent, tends to promote heat checking approximately in proportion to tungsten content.

steel to make them tougher, but may decrease hardness penetration slightly. Vanadium may also increase the red hardness of steel. It is used in this respect in quantities of 0.15 to 1.00 percent, in conjunction with chromium, tungsten, molybdenum and nickel in hot-working steels; 1 to 4 percent vanadium is usually in high-speed steels for the same purpose.

Molybdenum—This element increases hardness penetration, wear resistance, red hardness and inclines the steel toward oil-hardening. It encourages greater decarburization in forging and heat-treating. When used between 0.25 and 1.50 per cent with other alloy it increases toughness. It is used sometimes to replace tungsten in high-speed steels.

Cobalt—Cobalt is seldom used in any but high-speed steels. It is added to increase the red hardness of hot-work and especially cutting tools, so they may be used at higher operating speeds. It raises the temperature necessary for hardening, increases surface decarburization, and decreases toughness.

Nickel—Nickel has little effect on the hardenability of tool steel, but it does add to the toughness and possibly wear resistance when used with some hardening alloy like chromium.

SELECTING A STEEL

The tool user should first determine whether or not a water-hardening plain-carbon tool steel is satisfactory for his purpose. Straight carbon tool steels produce a hardened surface zone of limited depth with a softer core; they are capable of absorbing more shock than steels which harden through. When properly recognized, this is one of the outstanding advantages of carbon tool steel. He should change to other types when desiring (1) greater wear resistance, (2) greater toughness, (3) hardening accuracy and safety, and (4) red hardness or the ability of the tool to work when it becomes very hot. With plain-carbon water-hardening steel as a basis, the three groups of steels listed in Table 1 can be arranged as shown in the chart on the opposite page and used as a basis for selecting a steel with the foregoing four desirable characteristics.

In the chart the three steel groups, arranged in vertical columns, are further classified into the ten classes shown in Table 1. The arrows show the direction in which to move when selecting a steel with the aforementioned four characteristics.

If plain-carbon water-hardening steels are unsatisfactory, and better wear properties are desired, move upward in group I to the low-alloyed water-hardening class. If toughness is desired, move downward to the low-carbon low-alloyed water- or oil-hardening class.

If safer hardening properties are desired, move to the left and select one of the classes under group II; make a choice in proportion to the amount of wear required. The highest wear is found in Class *D* steels, which at the same time give the lowest toughness. For an increase in toughness with similar characteristics of

Cobalt	Nickel	Notes	General characteristics
.....	.....	1, 4	Medium wear; good toughness; medium distortion; partial depth hardening.
.....	.....	1, 2, 3, 4	High wear; medium toughness; some shrinkage; partial depth hardening.
.....	0.00–0.50	1, 5	Fair wear; high toughness; medium distortion; partial depth hardening.
0.00–4.00	0.00–1.00	1, 6, 7	Maximum abrasive resistance, lowest toughness; low distortion; deep hardening.
.....	.....	1, 2, 3, 5	Medium wear; medium toughness; medium distortion; deep hardening.
.....	0.00–0.50	1, 5	Medium wear; good toughness; very low distortion; deep hardening.
.....	0.00–2.50	1, 5	Fair wear; excellent toughness; medium distortion; medium deep hardening.
2.00–15.00	.....	1, 7, 8	High resistance to heat; low toughness; low distortion; deep hardening.
.....	.....	1, 8	Good heat resistance; good toughness; low distortion; deep hardening.
0.00–0.60	0.00–5.00	1, 8, 9	Fair wear; high toughness at heat; low distortion; deep hardening.

hardness found in class *D* high-carbon high-chromium steels, select class *E* steels, the common oil-hardening nondeforming type. For steels having wear and toughness characteristics similar to those of oil-hardening steels, but less susceptible to distortion, select one in class *F*, the air-hardening nondeforming variety. For maximum toughness accompanied by low distortion, select a tough alloy steel of the punch-and-chisel type.

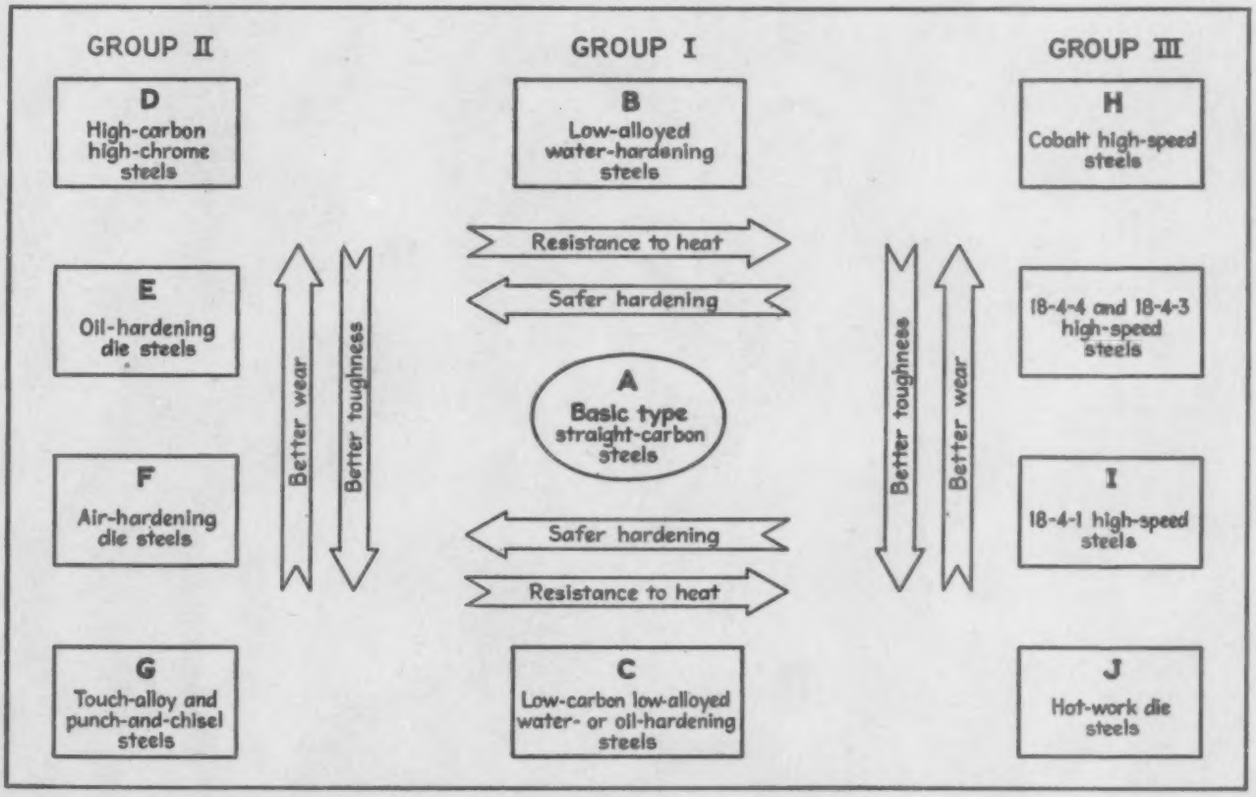
If resistance to heat is required, move to the right and select a steel in group III. As was the case in groups I and II, the steels with better wear resistance are found at the top of the chart, whereas steels with better toughness are found at the bottom.

For cutting steels where heat is generated, move to the upper right to class *H*. The steels here provide the maximum in heat resistance and includes the high-tungsten cobalt, high-molybdenum cobalt, 18–8–4 and 18–4–3 high-speed steels. For maximum toughness in cutting tools, select the common 18–4–1 steel. The latter are used for some hot-work dies, as well as cold work where the toughness and wear resistance of these steels are of value. For maximum toughness in hot work, select one of the hot-work steels, which resist scaling, checking and wear in contact with metals at red heat.

In general, low cost steels are found at the bottom of the chart, while high cost steels are at the top.

There are, of course, many special tools steels on the market offered for specific purposes and which, in general, have been designed for doing one type of job better than any of the 50 steels listed here. However, the chart can still be applied when selecting desirable characteristics in such types.

Typical applications of plain carbon tool steels are given in Table 3. The applications of the alloy steels in Table 2 are given in Table 4.



Tool and die steels in each of the three groups have definite working characteristics. The steels at the top are wear-resistant, while those at the bottom are tough. Basic selection can be made by following the arrows

Table 2—TYPES AND GENERAL ANALYSES OF TOOL AND DIE STEELS*

No.	Carbon	Manganese	Silicon	Tungsten	Chromium	Vanadium	Molybdenum	Cobalt	Nickel	Notes**	Types
1	1.10+	.....	.....	.....	.....	.....	.....	.....	.....	1	Carbon
2	0.95	0.15–0.35	0.15–0.35	.....	.....	.....	.....	.....	.....	1	Carbon
3	0.85	—0.15–0.35	0.15–0.35	.....	.....	.....	.....	.....	.....	1	Carbon
					STRAIGHT CARBON STEELS, LOW-ALLOYED, WATER-HARDENING, OIL OR WATER-HARDENING						
4	1.25–1.50	0.15–0.35	0.15–0.50	2.50–6.25	0.00–1.80	0.00–0.30	0.00–0.50	.....	.....	1, 2, 3	W-finishing
5	1.30–1.45	0.15–0.35	0.15–0.35	.....	0.00–0.35	0.00–0.30	.....	.....	.....	1, 3	C or C-V
6	1.10–1.30	0.15–0.35	0.15–0.35	1.00–2.50	0.00–1.00	0.00–0.30	.....	.....	.....	1, 2	High C, Low W
7	1.10–1.30	0.15–0.35	0.15–0.35	.....	0.10–1.20	0.00–0.30	.....	.....	.....	1, 3	Low Cr or Cr-V
8	1.10–1.30	0.15–0.35	0.15–0.35	.....	.....	0.00–0.30	.....	.....	.....	1	C or C-V
9	0.90–1.10	0.15–0.35	0.15–0.35	1.00–2.50	0.00–0.75	0.00–0.30	.....	.....	.....	1, 2, 3	High C, low W
10	0.90–1.10	0.15–0.35	0.15–0.35	.....	0.10–1.50	0.00–0.30	.....	.....	.....	1, 3	Low Cr or Cr-V
11	0.90–1.10	0.15–0.35	0.15–0.75	.....	.....	0.00–0.50	.....	.....	.....	1, 4	C or C-V
12	0.45–1.10	0.15–0.35	0.15–0.35	.....	0.40–1.40	0.00–0.35	0.00–0.35	.....	0.00–0.50	1, 3	Cr-Mo or Cr-V
13	0.70–0.90	0.15–0.35	0.15–0.35	.....	.....	0.00–0.30	.....	.....	.....	1	C or C-V
14	0.45–0.75	0.35–1.00	0.75–2.25	.....	0.00–0.60	0.00–0.35	0.00–0.60	.....	.....	1, 5	Si-Mn or Si-Mo
					INTRICATE DESIGNS — OIL- OR AIR-HARDENING						
15	1.80–2.50	0.15–1.20	0.15–1.00	2.00	10.50–14.00	0.00–1.25	0.00–0.30	0.00–1.00	0.00–1.00	1, 6, 7	High C, high Cr
16	1.80–2.40	0.15–0.60	0.15–0.50	.....	10.50–14.00	0.00–1.20	0.70–1.00	0.00–0.60	.....	1, 6, 7	High C, high Cr
17	1.30–1.70	0.15–0.60	0.15–0.50	.....	10.50–14.00	0.00–1.20	0.50–1.25	0.00–4.00	0.00–1.00	1, 6, 7	High C, high Cr
18	0.85–1.30	0.15–1.20	0.15–1.00	.....	4.50–13.00	0.00–0.75	0.45–1.25	0.00–0.60	0.00–1.00	1, 6, 7	High C, high Cr
19	1.10–1.30	0.35–0.95	0.15–0.35	.....	0.40– 1.75	.....	0.25–0.75	.....	.....	1, 5	Cr-Mo
20	1.10–1.30	0.15–0.70	0.15–0.35	1.00–2.50	0.35– 1.25	0.00–0.30	.....	.....	.....	1, 2, 3	High C, low W
21	1.10–1.30	0.35–0.70	0.15–0.35	.....	0.40– 1.75	0.00–0.30	.....	.....	.....	1, 3	Low Cr or Cr-V
22	0.80–1.10	1.00–2.25	0.15–0.50	0.00–1.10	0.90– 2.00	0.00–1.10	0.40–2.15	.....	0.00–0.50	1, 5	High Mn, low Cr
23	0.80–1.10	0.25–1.00	0.15–0.50	0.70–1.10	4.50– 6.50	0.35–1.10	0.40–2.50	.....	0.00–0.50	1, 5	Low Mn, high Cr
24	0.90–1.10	0.35–1.10	0.15–0.50	0.70–1.10	0.90– 1.60	0.00–0.30	0.00–0.50	.....	.....	1, 5	Cr non-deform
25	0.80–1.10	0.85–1.80	0.15–0.50	0.00–0.70	0.00– 0.90	0.00–0.30	0.00–0.35	.....	.....	1, 5	Mn non-deform
26	0.40–0.65	0.15–0.35	0.15–1.50	0.75–3.00	0.50– 2.00	0.00–0.50	0.00–0.35	.....	.....	1, 5	Low W-Cr
27	0.50–0.80	0.35–0.90	0.15–0.35	.....	0.50– 1.25	0.00–0.30	0.00–0.80	.....	1.00–2.50	1, 5	Cr-Ni-Mo
28	0.50–0.90	0.35–0.90	0.15–0.50	.....	0.00– 1.20	0.00–0.35	0.00–0.40	.....	0.00–0.50	1, 5	Cr-Mo, Cr-V or Mn-Mo
29	0.45–0.60	0.35–1.25	0.75–2.25	0.00–0.20	0.00– 0.75	0.00–0.60	0.15–2.00	.....	.....	1, 5	Si-Mo
					HIGH-SPEED TYPES — OIL- OR AIR-HARDENING						
30	0.70–0.90	0.15–0.35	0.15–0.35	18.00–23.00	3.50–4.75	1.25–2.50	0.00– 1.25	9.00–15.00	.....	1, 7, 8	W-Co high speed
31	0.65–0.90	0.15–0.35	0.15–0.35	17.00–21.00	3.50–4.75	1.25–2.50	0.00– 1.25	5.00– 9.00	.....	1, 7, 8	W-Co high speed
32	0.75–0.90	0.15–0.35	0.15–0.35	0.00– 2.00	3.50–4.75	1.25–2.50	7.00–10.00	3.00– 8.00	.....	1, 7, 8	Mo-Co high spd
33	0.65–0.80	0.15–0.35	0.15–0.35	17.00–20.00	3.50–4.75	0.75–1.50	0.00– 1.00	2.00– 5.00	.....	1, 7, 8	W-Co high speed
34	0.65–0.85	0.15–0.35	0.15–0.35	12.00–15.00	3.50–4.75	1.50–2.25	0.00– 0.75	3.00– 8.00	.....	1, 7, 8	W-Co high speed
35	0.90–1.30	0.15–0.35	0.15–0.35	17.00–19.00	3.50–4.75	2.50–4.00	0.00– 1.00	.....	.....	1, 8	18-4-4 & 18-4-3
36	0.75–1.05	0.15–0.35	0.15–0.35	17.00–19.00	3.50–4.75	1.50–2.50	0.00– 1.00	.....	.....	1, 8	18-4-2
37	0.55–0.80	0.15–0.35	0.15–0.35	16.00–21.00	3.50–4.75	0.50–1.50	.....	.....	.....	1, 8	18-4-1
38	0.70–1.30	0.15–0.35	0.15–0.35	5.00– 6.50	3.50–4.75	1.25–4.00	3.00– 6.50	.....	.....	1, 8	Mo-W high spd
39	0.70–1.30	0.15–0.35	0.35–0.35	.....	3.50–4.75	1.50–4.00	7.00– 9.00	.....	.....	1, 8	Mo-V high spd
40	0.65–0.85	0.15–0.35	0.15–0.35	1.00– 2.50	3.50–4.75	0.75–1.50	6.00– 9.50	.....	.....	1, 8	Mo-W high spd
41	0.55–0.80	0.15–0.35	0.15–0.35	13.00–15.00	3.50–4,75	0.75–2.20	.....	.....	.....	1, 8	14-4-2 & 14-4-1
42	0.45–0.60	0.15–0.35	0.15–0.35	16.00–19.00	3.00–4.50	0.50–1.25	.....	.....	.....	1, 8, 9	Low C high spd
					HOT-WORK TYPES — OIL- OR AIR-HARDENING						
43	0.25–0.60	0.15–0.35	0.15–0.35	12.00–16.00	2.50–4.50	0.30–0.60	.....	.....	.....	1, 8, 9	High W hot-wk
44	0.25–0.50	0.15–0.35	0.15–0.35	8.00–12.00	1.25–3.50	0.00–0.60	0.00–0.30	.....	0.00–2.25	1, 8, 9	W hot-work
45	0.30–0.60	0.15–0.75	0.35–1.50	4.00– 7.50	4.50–7.50	0.00–0.60	0.00–0.50	0.00–0.60	0.00–0.50	1, 8, 9	W-Cr hot-work
46	0.40–0.65	0.15–0.35	0.15–1.00	1.50– 3.00	0.75–2.00	0.00–0.50	0.00–0.35	.....	.....	1, 8	Low W-Cr hot work
47	0.30–0.50	0.15–1.40	0.80–1.10	0.00– 1.75	4.00–7.50	0.00–0.50	0.45–1.85	0.00–0.60	0.00–1.75	1, 8	Cr-Mo hot-work
48	0.40–1.00	0.15–0.75	0.15–0.75	.....	2.25–4.50	0.00–1.00	0.00–0.80	.....	.....	1, 8	Cr-Mo or Cr hot-work
49	0.30–0.60	0.35–0.80	0.15–0.50	.....	0.50–2.50	0.00–0.30	0.00–1.00	.....	1.25–5.00	1, 8	Cr-Ni-Mo
50	0.10–0.90	0.15–1.10	0.15–0.35	0.00– 0.50	0.00–1.50	.....	0.00–0.75	.....	1.25–3.50	1, 8	Cr-Ni-Mo

* The steel numbers refer only to this article and are not to be assumed as specific types or grades sold by the steel manufacturers. See Table 3 for greater ranges of carbon tool steels.

** The numerical notes in this column refer to the numbered footnotes in Table 1.

Data in Tables 1 and 3 are based on those presented by Harold B. Chambers, *Metal Progress*, June, 1940.

NOTE: This table excludes special brands of steels offered for very specific uses.

Steels may be heated in liquid baths and in gas, oil or electric furnaces. The majority of heating for forging and hardening is done in furnaces.

The temperature ranges of liquid baths are:

Water	Up	to	212 F.
Oil	Up	to	500 F.
Salt	300	to	2,300 F.
Lead	600	to	1,700 F.

Types of salt baths, their melting points and applications are given in Table 5.

Of all the metals, lead is the only one suitable as a commercial bath material and may be used for normalizing, annealing and heating all of the steels, and tempering high-speed steels. Select a covering whose kindling temperature is slightly below the temperature of the bath; for example, wood charcoal with a kindling temperature of 850 will give greater protection at a bath temperature of 900 F. than it will at 800 F. These coverings must be skimmed regularly to prevent oxidizing or scaling of the steel immersed in the baths.

Liquid coverings consist of sodium chloride, sodium carbonate and potassium carbonate. Cyanide mixtures are good but expensive.

Lead will adhere to the tool and die steel unless the latter is protected with a coated material. Sodium chloride can be used at temperatures below 1,475 F., in which case dip the part in liquid NaCl and then place it in the lead bath. After low-temperature heating, the part may have to be cleaned—do this by dipping in molten caustic soda immediately following its removal from the lead bath, and then quench in water.

HEATING PRECAUTIONS

Steels subject to decarburization may be heated in atmospheric type furnaces under accurately controlled temperature and atmospheric conditions. Also, decarburization can be prevented by packing the part in containers with protective material for heating in the usual commercial heating furnace.

Practically all the tool steels are subject to decarburization, because the carbon in hot steels migrates from the center and outer edges to the carbon-free skin. Conversely, when a steel does not decarburize readily it usually lacks the carbon content to support this migration. Therefore, exercise great care in heating all the tool steels. Decarburized surfaces can be removed by machining or grinding.

Increasing the heat for forging above 2,000 F. increases the depth of decarburization. Avoid decarburization at preforging and forging temperature so that the forgings can respond to heat treatment and thereby produce the physical properties expected.

Decarburization of some high-alloy steels, notably the high-speed steels, can be minimized in open-furnace hardening by the application of borax. Air-hardening tool steels can be protected against decarburization by applying special copper-bearing paint instead of borax.

FORGING

Heat tool and die slowly and uniformly prior to forging, permitting the heat to penetrate to the center of the piece. Heat the pieces in a preheating furnace before they are brought to the forging temperature to reduce the danger of rupture through rapid initial heating, as well as to decrease the time necessary to hold the piece at the highest temperature in the heating furnace. Preheating also permits the steel to be brought to the high temperature more rapidly, thus preventing excessive scaling, and reducing both decarburization and grain growth. If a preheater is not available, warm the piece before forging by placing it on top of the furnace or on a shelf in front of the charging door to remove the chill.

In general, allow fifteen minutes of soaking at the forging temperature for each inch of greatest thickness for carbon steels. Increase this to about half an hour for tungsten and high-chromium steels.

Forging should be done with a hammer of sufficient size to work the piece throughout, but not so heavy as to cause rupture. All reduction in cross section should be carried out by going from a square section to a square section. The corners should be knocked down on each successive reduction of section. If round or hexagonal sections are desired, the piece should be brought to the desired shape in the final hot-work operation. When

Table 3—TYPICAL APPLICATIONS OF CARBON TOOL STEELS

Carbon, per cent	CHARACTERISTICS AND APPLICATIONS
1.40+	Excellent wear resistance and poor toughness—for cutting extremely hard materials, such as chilled iron, hard forging; fine files; engraver's tools; hard wearing surfaces; hair clippers; tube mandrels.
1.30+	Excellent wear resistance and poor toughness — for turning; granite points; razors; bush hammers; scale pivots; dental tools; brass working, planer and slotter tools.
1.20+	Good wear resistance and fair toughness — small taps; reamers; drills; tube drawing dies and plugs; cutter's and forming tools; razors; mill picks; leather and glove dies; boring tools; paper and veneer knives.
1.10+	Good wear resistance and fair toughness — taps; reamers; milling cutters; nail dies; threading dies; blanking punches and dies; wood working, leather and paper knives; jeweler's dies; edge tools; pipe dies; mill picks; bushings; cold stamping dies; bush hammers; envelope dies; jeweler's rolls; pocket blades; peen hammers; bunter dies; sewing machine needles.
1.00+	Fair wear resistance and good toughness — trimmer dies; small punches and dies; small shear blades; axes; wood bits; small chisels; gang saws; channeller drills; saw swages; saws; peen hammers; embossing dies; shoe dies.
0.90+	Fair wear resistance and good toughness — cold header dies; mint dies; large punches and dies; pneumatic rivet sets and chisels; hand chisels; trimmer dies; vise jaws; nail sets; large shear blades; drifts; small hammer dies; clicker dies; springs.
0.80+	Low wear resistance and excellent toughness — rock drills; mason's hammers; shear blades; chisels; drop dies; track tools; hammer dies; cold sets; hammers; smith's tools; flatters; fullers; vise jaws; hot and cold bolt dies; needles; drop forging dies.
0.70+	Low wear resistance and excellent toughness — large hammer dies; well drills; cold sets; sledges; large shear blades; battering tools; button sets; needles; drop forging dies.
0.60+	Low wear resistance and excellent toughness — smith's shop tools; cupping tools; set-screws; wedges; crank pins and machinery parts.

Table 4—TYPICAL APPLICATIONS OF TOOL AND DIE STEELS*

Blacksmith tools	6 8 9 11 12 26 29 ..
Bolt clippers	8 11 13 14 29 .. .. ..
Boring tools	30 to 41 incl.
Brass-cutting tools	4 6 15 16 17 18 34 .. 35 36 37 38 39 40 41 ..
Broaches	6 15 20 24 25 26 34 35 36 37 38 38 40 41 .. ..
Burnishing tools	4 15 16 17 18 37 38 39
Bushings	15 24 25 26 .. ..
Chasers, thread	9 25 26 27 36 37 38 39
Chilled-roll turning:	
Roughing	30 to 41 incl.
Finishing	4 6 7 8 9 11 .. ..
Chisels:	
Cold-work	8 9 10 11 12 26 27 29
Engraving	27 28 29 37 38 39 .. ..
File cutting	35 36 37 38 39 40 41 ..
Hot-work	26 43 44 46 48 .. .. ..
Machinists	8 9 11 26 43 44 46 ..
Chuck jaws	11 24 26 29 .. ..
Circular forming tools:	
Ferrous	36 37 38 39 .. ..
Non-ferrous	4 20 36 37 38 39 .. ..
Cold sets	6 8 12 13 29 .. .. ..
Collets	25 26 27 28 .. ..
Creasers (hot)	37 38 39 43 44 46 48 ..
Crowning tools:	
Hot	26 37 38 38 43 44 46 48
Cold	6 8 37 38 39 .. .. ..
Cutters:	
Finishing	4 6 36 37 38 39 .. ..
Form	4 34 35 36 37 38 39 41
Gang	35 36 37 38 39 40 41 ..
Gear	30 to 41 incl.
Heavy-duty	30 to 41 incl.
Hot-work	37 43 44 46 48 .. .. ..
Pipe	7 8 9 11 26 29 44 ..
Rifling	35 36 37 38 39 40 41 ..
Threading	25 26 27 37 38 39 40 41
Cutting-off tools:	
Cold	30 to 41 incl.
Hot	43 44 46 48 .. ..
Dies:	
Burnishing	4 15 16 17 18 37 .. ..
Coining	11 13 15 16 17 18 25 26
Cold bending	12 26 28 29 .. ..
Cold blanking	4 7 8 11 13 15 16 17 18 20 23 24 25 37 .. ..
Cold cutting	15 16 17 18 20 37 .. ..
Cold extrusion	4 8 13 15 16 17 18 24 25 37 .. ..
Cold forming	4 7 10 15 16 17 18 23 24 25 26 .. ..
Cold heading	8 11 13 15 16 17 18 27 37 .. ..
Cold nut	6 8 11 13 15 16 17 18 37 .. ..
Cold swaging	8 15 16 17 18 29 37 ..
Cold thread roll	15 16 17 18 37 .. .. ..
Cold trimmer	15 16 17 18 23 24 25 37
Crimping	15 16 17 18 24 25 26 ..
Deep drawing	4 9 15 16 17 18 20 26
Die casting	10 12 43 44 46 48 50 ..
Embossing	7 11 25 26 .. ..
Engraver's	4 11 26 .. ..
Hot bending	37 43 44 46 48 .. .. ..
Hot blanking	34 36 37 43 44 46 48 ..
Hot bolt and nut heading	10 12 43 44 46 48 .. ..
Hot extrusion, forming, gripper, heading trimming	10 12 26 37 37 39 41 43 44 46 47 48 49 .. .. ..
Hot nut	12 34 37 43 44 46 48 ..
Hot punching	10 12 43 44 46 48 .. ..
Hot swaging	10 12 15 16 17 18 26 43 44 46 48 49 50 .. .. ..
Hot roll-thread	15 16 17 18 26 37 38 39
Hot insert	37 43 44 46 48 .. .. ..
Lamination	15 16 17 18 24 25 26 37 38 39 .. ..
Non-deforming	22 23 24 .. ..
Plastic	24 25 26 29 43 44 46 48
Roll threading	15 16 17 18 23 24 25 26 37 38 39 .. ..
Screw cutting	35 36 37 38 39 40 .. ..
Stamping	8 11 13 15 16 17 18 24 25 26 37 38 39 .. .. ..
Threading	7 8 11 13 20 24 25 26 37 38 39 .. ..
Wire drawing	4 10 15 16 17 18 .. ..
Drills:	
Center	7 20 35 36 37 38 39 ..
Flat	7 11 35 36 37 38 39 ..
Gun barrel	30 to 41 incl.
Twist	7 35 36 37 38 39 .. ..
Stone	8 11 13 .. ..
End mills	35 36 37 38 39 .. .. ..
Forming tools	4 8 15 16 17 18 20 .. 24 and 30 to 41 incl.
Gages	4 7 15 16 17 18 24 25 26 .. ..
Hot piercing, punching and shearing tools	15 16 17 18 20 26 37 38 39 43 44 46 47 48 49 50
Hobs	4 6 8 9 20 25 26 35 36 37 38 39 .. ..
Knives:	
Cloth	4 7 15 16 17 18 20 ..
Hot shear	See hot piercing
Cold shear	8 11 15 16 17 18 24 29 37 38 39 .. ..
Paper	7 15 16 17 18 20 37 38 39 .. ..
Woodworking	8 9 15 16 17 18 25 27 28 37 38 39 .. ..
Leather	8 9 27 28 29 .. .. ..
Knurling tools	7 15 16 17 18 20 24 25 26 29 37 38 39 .. .. ..
Lathe centers	10 15 16 17 18 20 24 37 38 39 40 41 .. ..
Lathe tools	30 to 41 incl.
Mandrels:	
Hot	43 44 46 48 49 .. .. ..
Cold	6 8 9 11 12 13 15 16 17 18 .. ..
Master form tools	15 16 17 18 20 24 25 26
Nut piercers:	
Cold	11 15 16 17 18 .. .. ..
Hot	12 37 38 39 43 44 46 48
Planer tools	30 to 41 incl.
Pneumatic tools:	
Backing out	11 12 26 29 46 .. .. ..
Beading	8 11 12 26 29 46 .. ..
Chisels	8 12 26 29 46 .. .. ..
Rivet busters	7 8 11 12 26 29 48 ..
Rivet sets	7 8 10 11 12 13 26 29 48 .. ..
Scarfing	7 11 12 26 29 46 48 ..
Punches:	
Abrasive	15 16 17 18 34 .. .. ..
Center	8 12 26 27 28 29 37 38
Deep drawing	4 7 12 16 15 16 25 26 29 .. ..
Forming	15 16 25 26 .. ..
Hand	8 11 29 37 38 39 .. ..
Hot	See hot piercing
Trimming	12 15 16 17 18 29 37 38
Reamers:	
Bridge	8 35 36 37 38 39 .. ..
Expansion	7 8 25 26 37 38 39 ..
Finishing	4 6 7 8 9 36 37 38
Hand	4 6 7 8 9 20 25 26 36 37 38 39 .. ..
Inserted blade	4 25 34 35 36 37 38 39
Rifling tools	4 7 8 11 13 26 28 36 37 38 39 .. ..
Rivet sets (compression)	12 26 43 44 46 48 .. ..
Rolls:	
Beading	15 16 17 18 .. ..
Bending	7 10 15 15 17 18 25 26
Burnishing	4 7 15 16 17 18 .. ..
Edging	10 15 16 17 18 .. .. ..
Engraver's	7 15 16 17 18 24 25 26 37 38 39 .. ..
Hot	26 37 38 43 44 46 47 48 49 .. ..
Rim	7 10 12 15 16 17 18 26
Seaming	10 12 15 16 17 18 25 26
Expanding rolls	8 11 13 29 .. ..
Scrapers	4 6 7 8 9 15 16 15 18 20 .. ..
Shaper tools	30 to 41 incl.
Shear blades:	
Cold—heavy	8 12 15 16 17 18 26 46
Cold—light	8 12 15 16 17 18 23 24 25 26 46 .. ..
Hot	See not piercing.
Shock tools	See pneumatic tools.
Slitters	6 8 9 15 16 17 18 25 26 .. ..
Stamping:	
Cold	4 6 8 9 24 25 26 27 28 .. ..
Hot	43 44 45 46 47 48 49 50
Swaging	See dies, swaging.
Taps	6 7 8 11 13 15 16 17 18 25 26 37 38 39 .. ..
Taps, stay-bolt	4 6 8 20 37 38 39 ..
Tire-turning	30 to 41 incl.
Wire-drawing grips	8 11 13 26 29 .. .. ..

*The numbers in this table refer to the steels listed in Table 2. See Table 3 for applications of Carbon tool steels.

NOTE: This table was compiled to illustrate applications for the steels discussed in this article. The applications are typical ones only, and are not to be construed as precise recommendations.

forging rounds, use V-type dies—this applies particularly to high-speed and high-carbon high-alloy tool steels.

Most steels have some air-hardening properties; therefore, they should be cooled slowly after forging and protected from moisture and draft. Cool them by burying either in dry ashes, lime, silocel or some other retardent medium.

If the forgings are of intricate or irregular shape, they should be annealed after forging to remove stresses set up by forging and cooling.

If a previously hardened tool is salvaged by reforging to make a smaller tool, it should be annealed before reforging. Forging temperature for all types of tool steels are given in Table 6; the higher temperatures should be used for large sections and heavy or rapid reductions, while the lower temperatures are for small sections and lighter reduction.

NORMALIZING

Normalizing between forging and annealing operations is recommended for grades of tool steels other than those with air-hardening properties. The former types should be normalized by heating slowly to a temperature slightly above the critical temperature range and holding it there a sufficient time to be heated uniformly throughout. This time ranges from 15 to 60 min. They should then be air cooled. This refines the grain structure, relieves forging stresses, and produces a uniform structure in the steel. The stresses set up by air cooling are not as severe as those developed during forging, and they are relieved in the annealing process. If annealing is necessary do so immediately after normalizing.

ANNEALING

Tool steels which are to be machined or tooled must be annealed prior to hardening. The steel to be annealed may be placed in a tight container to keep out furnace gases. When possible, pack them in cast iron chips, lime, mica, or similar material to prevent scaling, decarburization and too rapid changes in temperature. Do not let the steel come in contact with the container. Never cool in air. If not so packed, annealing should be done in controlled-atmosphere furnaces. Always allow sufficient time at the annealing temperature to permit the heat to penetrate to the center of the tool. Temperatures are given in Table 6.

Tool steels with high percentages of chromium, tungsten, vanadium and molybdenum should be preheated before annealing at a rate of ½–1 hour per inch of thickness. Other steels should be raised to the annealing temperature slowly and uniformly. All steels should be held at the annealing heat from one to six hours, depending upon the size of the thickest section and the shape of the piece. Prolonged soaking will coarsen the grain, and make subsequent refinement difficult. Hold the annealing temperature long enough for complete penetration of heat and readjustment of grain.

After annealing, cool slowly in the furnace or in a good heat-insulating material. In general, the slower the cooling, particularly through the critical range, the softer will be the steel. As the alloy content increases, the slower the steel must be cooled. Recommended maximum cooling rate is 50 F. per hour down to 1,000 F., after which it can be accelerated.

Tool steel bar stock is generally furnished in the annealed condition, and usually requires no further annealing prior to machining or treatment. However, after severe machining operations, a stress-relieving sub-annealing treatment is recommended. This is accomplished by heating the steel to between 900 and 1,200 F. and cooling slowly. For high-speed steels, a full anneal should be used. This treatment aids in minimizing warpage, size change, and breakage in hardening.

SPHEROIDIZING

Some steel companies recommend that carbon and carbon-vanadium steels having more than 0.90 per cent carbon be spheroidized prior to machining and hardening. Do this by annealing for a long time at a temperature of approximately 1,400 F. It can be expedited by quenching in oil from temperatures between 1,500 to 1,600 F., or by air cooling from between 1,600 to 1,650 F., either cooling operation being followed by annealing at about 1,400 F. Hold the pieces at annealing temperature sufficiently long and cool slow to produce the spheroidized structure.

HARDENING

Hardening temperatures for tool steels are given in Table 6.

Table 5—RECOMMENDED SALT-BATH MIXTURES AND TEMPERATURES

Mixtures[A], per cent by weight	Melting temp., F.	Type of bath	Recommended temperatures Min.	Max.
23.3% $LiNO_3$ + 60.4% KNO_3 + 16.3% $NaNO_3$	250	L	300	1100
53.0% KNO_3 + 7.0% $NaNO_3$ + 40.0% $NaNO_2$	285	L	335	1100
[B]56.0% KNO_3 + 44.0% $NaNO_3$	295	L	345	1100
51.3% KNO_3 + 48.7% $NaNO_3$	425	L	475	1100
50.0% $NaNO_3$ + 50.0% $NaNO_2$	430	L	480	1100
45.0% LiCl + 55.0% KCl	666	M	766	1650
[C]31.0% $BaCl_2$ + 48.0% $CaCl_2$ + 21.0% NaCl	806	M	906	1650
66.5% $BaCl_2$ + 5.2% KCl + 28.3% NaCl	939	M	1039	1650
[C]67.0% $CaCl_2$ + 33.0% NaCl	941	M	1040	1650
48.1% $BaCl_2$ + 30.7% KCl + 21.2% NaCl	1026	M	1125	1650
27.0% NaCl + 73.0% $SrCl_2$	1049	M	1150	1650
[D]50.0% KCl + 50.0% Na_2CO_3	1085	M	1185	1650
[C]35.7% $BaCl_2$ + 50.7% $CaCl_2$ + 13.6% $SrCl_2$	1110	M	1200	1650
[C]50.3% $BaCl_2$ + 49.7% $CaCl_2$	1112	M	1215	1650
61.0% KCl + 39.0% KF	1121	M	1225	1650
[D]56.3% Na_2CO_3 + 43.7% NaCl	1177	M	1280	1650
[C]81.0% $CaCl_2$ + 19.0% KCl	1184	M	1285	1650
70.3% $BaCl_2$ + 29.7% NaCl	1209	M,H	1310	2500
[B]56.0% KCl + 44.0% NaCl	1220	M	1330	1650
72.6% NaCl + 27.4% NaF	1247	M,H	1347	2500
70.0% BaF_2 + 15.0% CaF_2 + 15.0% MgF_2	1454	H	1800	2500
83.0% $BaCl_2$ + 17.0% BaF_2	1551	H	1800	2500
48.0% CaF_2 + 52.0% MgF_2	1738	H	1835	2500

[A] Plain sodium nitrate can be used for low-temperature baths for temperatures between 650–1100 F.
L = Low-temperature baths, recommended for quenching and tempering carbon and low-alloy steels.
M = Medium-temperature baths, recommended for normalising, annealing and hardening carbon and alloy steels, and for quenching and tempering high-speed steels.
H = High-temperature baths, recommended for hardening high-speed steels.

[B] Most desirable for low-temperature baths because of wide temperature range available; however, if the low temperatures are not to be used, one of the other mixtures will be cheaper.

[C] Calcium chloride has a tendency to corrode steel, and is not a desirable constituent.

[D] Carbonates in salt bath tend to decarburize steel. Such mixtures are used in heating steel when sodium cyanide is added, which prevent formation of soft skin, providing the carbon is not over 0.75 per cent. Some steel treaters question this practice.

[E] This mixture is one of the easiest to handle.

NOTE: The medium-temperature baths are chloride mixtures, and gradually oxidise. Addition at regular intervals of ¼ — ½ per cent of the weight of the bath of a rectifier (boric acid, fused borax, or boric oxide) usually form a sludge which can be removed. Such rectifiers are of no use when added to a chloride-carbonate bath.

Lithium nitrate	= $LiNO_3$	Lithium chloride	= LiCl	Potassium fluoride	= KF
Potassium nitrate	= KNO_3	Potassium chloride	= KCl	Sodium fluoride	= NaF
Sodium nitrate	= $NaNO_3$	Barium chloride	= $BaCl_2$	Barium fluoride	= BaF_2
Sodium nitrite	= $NaNO_2$	Calcium chloride	= $CaCl_2$	Calcium fluoride	= CaF_2
Sodium carbonate	= Na_2CO_3	Sodium chloride	= NaCl	Magnesium fluoride	= MgF_2
		Strontium chloride	= $SrCl_2$		

Heating for hardening is most rapid in molten baths, somewhat slower in open or semi-muffled fuel-fired furnaces and slowest in electric furnaces. Use of salt or lead baths reduces the heating time required by approximately a half. The tool, however, should be warmed or preheated before immersing in the heating medium.

Place the steel in the furnace so that the maximum surface is exposed. Place supports under the tool to raise it from the furnace bottom, thus allowing better heat circulation; this is especially desirable with intricate-shaped tools. Place the supports so that the part will not sag in plastic state, which is one cause of distortion.

Cylindrical tools or parts of intricate shapes that tend to heat non-uniformly should be rotated occasionally.

Hold the tool steel at heat long enough to insure uniform heating throughout the section of the piece. Usually steels of high alloy content require more time.

If tool steel is heated above a low red heat while in contact with scale, it will be decarburized. Therefore, keep the steel, furnace hearth and

TABLE 6—TYPICAL HEAT TREATMENTS FOR TOOL AND DIE STEELS [A]

Steel No.	Types	Forging [C] Forging temp., F.	Normalize Stop forging at	Normalize after forging, F.	Annealing Temp. range, F.	Annealing Annealed Brinell hardness	Hardening [D] Preheating temp., F.	Hardening temp., F.	Quenching [E] media	Tempering [F] No. temp., F.
1	Carbon [B]	1900–1950	1550	1450–1525	1360–1450	160–200	.....	1400–1525	W,B	300– 650
2	Carbon [B]	1850–1875	1475	1450–1500	1360–1450	160–200	.....	1400–1475	W,B	300– 650
3	Carbon [B]	1825–1550	1475	1550–1650	1360–1450	160–200	.....	1400–1450	W,B	300– 650
4	W-finishing	1850–1950	1600	Don't	1450–1500	185–215	1200–1300	1450–1550	W,B	300– 600
5	C or C-V	1800–2000	1600	1700–1800	1350–1450	180–220	.....	1400–1500	W,B	300– 900
6	High C, low W	1800–1950	1600	1700–1800	1450–1600	185–215	.....	1475–1650	O	350– 600
7	Low Cr or Cr-V	1800–2000	1600	1600–1800	1400–1500	210–235	.....	1430–1530	W	300– 900
8	C or C-V	1800–2000	1550	1550–1700	1350–1450	170–210	.....	1400–1500	W,B	3J0– 550
9	High C low W	1800–1950	1600	1700–1800	1450–1500	190–225	.....	1575–1650	O	350– 550
10	Low Cr or Cr-V	1800–1950	1600	1700–1800	1450–1475	200–230	1200–1300	1575–1625	O	350– 550
11	C or C-V	1800–2000	1500	1550–1650	1400–1570	160–200	.....	1400–1500	W,B	300– 900
12	Cr-Mo or Cr-V	1800–1900	1500	1500–1550	1475–1500	160–200	.....	1400–1500	W,B	300– 900
13	C or C-V	1800–2000	1500	1400–1600	1375–1450	160–200	.....	1375–1575	W,B	300– 900
14	Si-Mn or Si-Mo	1850–1950	1550	Don't	1450–1500	200–225	.....	1650–1750	O	500– 650
15	High C, high Cr	1800–1900	1600	Don't	1600–1650	230–255	1250–1400	1700–1750	O,A	400–1000 [H]
16	High C, high Cr	1800–1900	1600	Don't	1600–1650	225–245	1400–1500	1700–1900 [G]	O,A	400–1000 [H]
17	High C, high Cr	1800–1900	1600	Don't	1600–1650	215–235	1400–1500	1800–1900	A	400–1000 [H]
18	High C, high Cr	1800–1900	1600	Don't	1600–1650	200–230	1200–1400	1800–1900	A	400–1000 [H]
19	Cr-Mo	1850–1950	1500	1550–1650	1400–1425	185–215	.....	1475–1550	O	600–1000
20	High C, low W	1800–1950	1600	1650–1750	1450–1475	190–225	1200–1300	1575–1625	O	350– 550
21	Low Cr or Cr-V	1850–2000	1650	1750–1800	1400–1480	200–230	.....	1430–1500	O	300– 900
22	High Mn, low Cr	1950–2000	1500	Don't	1425–1450	200–230	1180–1220	1550–1625	A	300–1300
23	Low Mn, high Cr	1975–2250	1750	Don't	1600–1650	180–220	1200–1450	1750–1850	A	300–1100
24	Cr non-deforming	1800–1950	1600	1625–1657	1425–1450	185–215	1150–1250	1450–1500	O	325– 550
25	Mn non-deforming	1800–1900	1600	1550–1650	1425–1450	180–210	1200–1250	1400–1550	O	300– 500
26	Low W-Cr	1800–1950	1500	Don't	1450–1500	180–216	1300–1350	1650–1800	O,A	600–1000
27	Cr-Ni or Cr-Ni-Mo	1850–1950	1550	1550–1650	1400–1450	170–200	.....	1475–1625 [I]	O	600–1000
28	Cr-Mo, Cr-V or Mn-Mo	1800–1900	1500	1500–1550	1450–1500	185–215	.....	1400–1500	O	350– 750
29	Si-Mo	1800–1950	1600	1575–1625	1450–1500	200–230	.....	1525–1675	W,B,O	350– 800
30	W-Co high speed	2100–2200	1800	Don't	1600–1650	230–255	1500–1600	2325–2375	O,A,MB,P	1000–1150
31	W-Co high speed	2100–2200	1700	Don't	1625–1675	223–248	1500–1600	2325–2375	O,A,MB,P	1000–1150
32	Mo-Co high speed	1900–2000	1650	Don't	1550–1600	217–241	1400–1500	2200–2250	O,A,MB,P	950–1100
33	W-Co high speed	2050–2150	1700	Don't	1600–1650	223–248	1500–1600	2350–2400	O,A,MB,P	1000–1150
34	W-Co high speed	2050–2150	1700	Don't	1600–1650	223–248	1500–1600	2325–2375	O,A,MB,P	1000–1150
35	18-4-4 and 18-4-3	1950–2100	1800	Don't	1600–1650	228–255	1500–1600	2250–2300	O,A,MB,P	1050–1100
36	18-4-2	2000–2150	1700	Don't	1600–1650	223–248	1450–1600	2250–2350	O,A,MB,P	1000–1050
37	18-4-1	2000–2150	1700	Don't	1600–1650	217–241	1450–1600	2250–2350	O,A,MB,P	850–1150
38	Mo-W high speed	1950–2050	1650	Don't	1550–1600	217–241	1450–1550	2200–2300	O,A,MB,P	1100–1150
39	Mo-V high speed	1900–2000	1650	Don't	1550–1600	200–228	1400–1500	2150–2250	O,A,MB,P	950–1100
40	Mo-W high speed	1900–2000	1650	Don't	1550–1600	200–228	1400–1500	2150–2250	O,A,MB,P	950–1100
41	14-4-2 and 14-4-1	2000–2100	1700	Don't	1600–1650	223–248	1500–1600	2325–2375	O,A,MB,P	1000–1150
42	Low C high speed	2050–2150	1700	Don't	1600–1650	205–225	1450–1600	2250–2350	O,A,MB,P	1000–1150
43	High W hot-work	2050–2150	1650	Don't	1600–1650	225–250	1500–1550	1850–2150	O,A	1000–1250
44	W hot-work	2050–2150	1650	Don't	1600–1650	220–225	1500–1550	1850–2150	O,A	1000–1250
45	W-Cr hot-work	2000–2100	1700	Don't	1600–1650	205–230	1500–1550	2100–2150	O	600– 800
46	Low W-Cr hot-work	1850–1950	1550	Don't	1450–1500	185–215	1500–1550	1650–1750	O	350– 650 [J]
47	Cr-Mo hot-work	2000–2100	1500	Don't	1500–1550	205–230	1500–1550	1775–1825	A	1000–1200
48	Cr-Mo or Cr hot-work	1850–1950	1600	Don't	1450–1500	185–215	1400–1500	1650–1825	A	600–1100
49	Cr-Ni or Cr-Ni-Mo	1850–1950	1500	1575–1625	1400–1450	185–215	.....	1475–1650	O [K]	600–1100
50	Cr-Ni or Cr-Ni-Mo	1700–2000	1500	1525–1575	1425–1500	160–215	.....	1450–1625	O	300– 500

[A] For chemical analyses of these steels, see Table 2. The steel numbers apply only to this article and not to specific types sold by steel manufacturers.

[B] Temperatures for treating carbon steel may vary from those given here, depending on the carbon content; however, the proportional variation given for the 0.85–1.10 carbon steels will apply to others of lesser or greater carbon content.

[C] These temperatures apply to re-forging semi-finished billets or bars and differ from steel-mill practice. Forging preheating temperatures should be 500–600 F. below the forging temperatures given.

[D] Hardening temperatures used will depend on the size of the piece; in general, the lower and higher temperatures are for small and large sizes, respectively.

[E] Quenching media: W = water, B = brine, O = oil, A = air, MB = molten lead bath, P = water-cooled plates.

[F] The range of tempering temperatures given apply to typical uses of the steels. Temperatures lower than those given are seldom used; however, temperatures higher than those given may be used, depending on the hardness and properties desired in the finished tools or dies. The lower the tempering temperature, the higher will be the hardness; conversely, the higher the tempering temperature, the lower the hardness.

[G] The range for oil hardening is 1700–1800 F., while that for air hardening is 1800–1900 F.

[H] Some companies recommend that it is not desirable to temper these steels between 600–800 F.

[I] This steel sometimes is not hardened when used for die-casting steels especially when the material to be die cast is very soft.

[J] When this steel is to be used in dies and tools for high-temperature work, temper at 1000–1250 F.

[K] This steel can be water hardened when the chromium content is low.

containers as free as possible from scale.

Cold tools should be charged at comparatively low furnace temperatures, below 1,000 F. Avoid sudden changes in temperatures, except for those steels in Table 6 for which preheating is recommended. For these steels a sudden change is permissible when changing from the preheat to the high-heat temperatures.

Steels requiring a hardening temperature above 1,800 F. should be preheated in a separate furnace or preheating chamber to at least 1,400–1,600 F. then brought rapidly up to the hardening temperature in the hardening furnace. Steels having lower hardening temperatures may be preheated at least to 1,150–1,300 F. Double or triple preheats of 600, 1,200 and 1,550 F. are recommended for steel high in chromium, tungsten, vanadium and molybdenum.

When hardening small or intricate-shaped pieces, use the lower recommended temperature ranges given in Table 6. Use the higher ranges for larger pieces.

It is recommended that the lowest temperature be used which will effectively harden the steel.

When hardening differentially, it is important not to have a sharp line of demarcation between the hardened and unhardened parts.

When a differential chill is desired, have the quenching apparatus so arranged that a uniformly strong flow of quenching medium washes over the sections to be more deeply hardened.

Whether or not a pyrometer is available, it is advisable whenever possible to determine the best hardening temperature before starting to treat tools, especially if they are to be made of a grade of steel differing from that used in regular shop practice. This may be done by hardening some small specimens from temperatures below, above, and at the temperature which is recommended to be the correct hardening temperature for that grade of steel. The pieces should be nicked prior to hardening. After hardening they should be broken at the nick. A study of the fractures will show which temperature produces the best grain refinement. The hardening range can also be determined by taking hardness readings on the hardened pieces. As soon as the proper range is approached, a rapid increase in hardness will result. Usually a combination of both hardness and fracture comparisons will give the desired information.

Surface deterioration through scaling and decarburizing, especially with air- and oil-hardening die steels, can be minimized by pack hardening, or using atmosphere-contolled furnaces. In the former case the tools are packed in containers with protecting material such as cast-iron chips, sand or partially spent carburizing material prior to charging in the furnace. In these cases, heating progresses slowly, and the time necessary for soaking is increased, which are sometimes desirable.

Start tempering immediately after hardening, preferably when the steel is still warm.

It is recommended that tools should not be rehardening unless they are given a stress-relieving treatment before the rehardening operation.

HEAT-TREATING DATA

Aside from the heat-treatment for tool and die steels given in Table 6, other specific recommendations can be made. These are as follows:

Carbon Steels—Heat slowly to 1,400 F. before normalizing temperatures are applied. Hold at the normalizing temperature 50–60 min. Heat slowly and uniformly to the recommended annealing temperatures, and hold the annealing heat from one to four hours. Cooling rate from the annealing temperatures should be 50 F. max. per hour to 1,000 F.

Heat the steels slowly up to the hardening temperatures. When using brine for the quenching medium, use a ten percent solution by weight held at 70–80 F. Remove the tool from the bath while still warm, but not before it is cooled to about 200 F.

Low Alloy Steels—Carbon steels with small percentages of vanadium, chromium and molybdenum added for their effects on keeping the grain size small, have in general the same hardening characteristics as carbon steels. With tungsten, chromium and molybdenum above 2.00, 4.00 and 1.50 per cent, respectively, especially when high percentages of carbon are present, the low-alloy steels should not be normalized. After forging, these steels with the percentage of tungsten, chromium and molybdenum just quoted should be cooled in a heat-insulating retardent medium to avoid air hardening. Such steels are easily air hardened and subject to dangerous cooling stresses unless properly handled. They should be heated slowly to betwen 1,550 and 1,500 F. prior to bringing them rapidly to forging temperatures. The same temperature range applies for preheating prior to reaching the normalizing temperatures. They should be held at normalizing heat from 50 to 60 min. Attain the annealing temperatures for these steels slowly and uniformly, and hold at the annealing heat from one to four hours. Cooling rate should be 50 F. maximum down to 1,000 F.

High-Carbon High-Chrome Steels—Do not normalize these steels after forging.

Heat them at the annealing temperature for one hour per inch of thickness, and hold the annealing heat from one to four hours. After annealing, the maximum cooling rate should be 50 F. per hour down to 1,000 F. and accelerate from there if desired.

All these types tend to decarburize on heating, therefore, pack them in cast-iron chips or spent charcoal during heating, or heat them in specially designed furnace having properly controlled atmospheres. Where edge strength is desired then pitch coke may be tried in place of charcoal.

Always preheat the steels prior to attaining the hardening temperature; hold at the preheating temperature until completely uniform, then transfer to the hardening temperature. The soak at hardening heat will vary with the size of the tool or die, but should be about three times as long as that used for similar size carbon tool steels. High tempering temperatures may be valuable for dies that must resist heat.

These steels are readily nitrided either in ammonia bath or by tempering at 1,000 F. in cyanide mixtures.

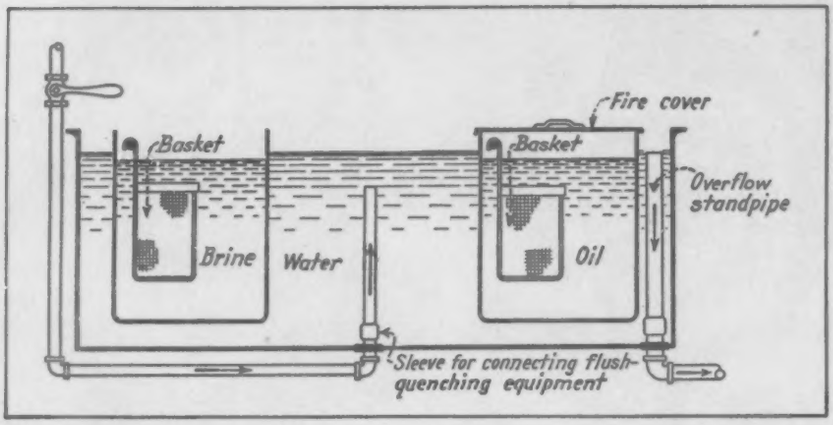
Do not temper below 400 F. because these steels lose toughness at the lower tempering ranges. They should be heated slowly to the desired tempering heat to prevent cracking.

Non-Shrinking Oil-Hardening Steels—Steel should become black after forging before charging in a normalizing furnace, but heat slowly to 1,500 F. before normalizing temperatures are applied. Hold the normalized temperature from 50 to 60 min.

For annealing, heat slowly and uniformly until the annealing temperature is reached and hold that temperature from one to four hours. Cool at 50 F. maximum per hour until 1,000 F. is reached, at which point the cooling may be accelerated. Pack anneal in cast-iron borings, graphite, or spent charcoal.

The steel should be preheated slowly before the hardening temperatures are attained. To minimize distortion of high-manganese types, do not soak at the hardening temperature. Other types may be soaked for one-half hour to attain maximum hardness; however, the lower the soaking time the lower will be the distortion. Pack hardening in spent charcoal or graphite is the usual procedure.

The quenching oil should be kept between 100 and 125 F., and the



In this convenient quenching layout, the fresh water can be adjusted to any desired level, which adjustment may be necessary when using flushing equipment that must be operated in air. The flushing equipment is used for differential quenching

Table 7—SALT SOLUTIONS

Salinometer reading	Per cent of salt	Lb. of salt per gal. solution	Degrees Baume
0	0.00	None	1.00
10	2.65	0.22	2.60
20	5.30 [A]	0.46	5.20
30	7.95 [A]	0.70	7.80
40	10.60 [A]	0.95	10.40
50	13.25	1.21	13.00
60	15.90	1.48	15.60
70	18.55	1.76	18.20
80	21.20	2.05	20.80
90	23.85	2.35	23.40
100	26.50 [B]	2.66	26.00

[A] Most satisfactory for brine baths.
[B] Saturated solution.
NOTES: Brine is a good coolant for quenching water-hardening steels in a still tank.
Hold brine baths between 70–100 the year round for best results.
Even though excessive amounts of salt in a solution decrease the amount of air which will dissolve in it, the quenching action will be slower. A saturated solution quenches so slowly that a water-hardening steel will barely harden in it.

steel should not be cooled below the temperature of boiling water.

Reheat immediately after quenching for tempering. When using a furnace with atmosphere control, refer to the steel producer for the atmosphere which will help to prevent skin softness. In an atmosphere of cracked oils, do not drop oils too fast or carburization of the surface will result.

Air-Hardening Steels—All of the steels in this group should never be normalized after forging, but cooled in a retardent such as lime, ashes or silocel.

For high-manganese low-chromium and low-manganese high-chromium air-hardening steels, pack hardening is suggested on large parts to insure maximum surface hardness. The steels should always be preheated until thoroughly soaked at 1,200 F. and then heated slowly to the hardening temperature. They should be held at the hardening temperature one hour per inch of average thickness and then be air cooled.

If the piece is large, an air blast is recommended, which should be directed on the working face during cooling. These steels should be cooled in the tempering furnace to 100–150 F., and then slowly heated to the tempering temperature, where they should be held for at least 1½-hr. per inch of rated thickness.

High-Speed Steels—Data on high-speed steels were presented in a previous article on the working of metals. (*AM*-Vol. 84, pp. 93–100.)

QUENCHING

The most common quenching mediums are (1) water and aqueous solutions of salts, acids and alkalis, (2) mineral, vegetable and animal oils, (3) air, (4) molten-lead bath, and (5) water-cooled steel plates. The latter two are seldom used except for high-speed steels.

The quenching rate of water drops with the rise of temperatures; near the boiling point it has ten percent of quenching rate at 68 F. Quenching in a still water bath is not recommended for tool steels, but if used the tool should be moved either slowly up and down or rotated; a violent swishing action is objectionable.

Atmospheric gases which accumulate in the water are thrown out of solution by the boiling action of the hot tools and form bubbles on the surface of the tools, especially in holes or recesses. This results in soft spots and internal strains which are likely to crack or weaken the tools.

Flush quenching is used when a differential chill is desired. The quenching apparatus must be so arranged that a uniformly strong flow of quenching medium washes over the section to be more deeply hardened. Tool life can sometimes be increased several times by flush quenching. This is particularly true of cold-forging tools, such as used for upsetting, coining or extruding cold metals. Flushing fixtures are usually employed for water quenching, and fresh water is just as good as brine for this purpose, since the rapid action of the water prevents gas pockets from forming.

Salt solutions prevent the absorption of atmospheric gases, and overcome the objection to fresh-water quenching. Rock salt can be dissolved in water up to 26 per cent, which is called a saturated solution. Percentages of salt, and pounds of salt per gallon of solution, for a salt bath are given in Table 7 above. The greater the percentage of salt used, the slower will be the quenching action. The most satisfactory brine bath will contain between five and ten percent salt, and is the most desirable coolant available for quenching water-hardening tool steels in a still tank.

A five percent solution of caustic soda in water is one of the fastest and most efficient quenching baths available. It is corrosive to clothing and skin and is seldom used.

Best and most uniform results will be secured if a water and brine bath is kept between 70 and 100 F. the year round.

High-temperature baths of molten salt or metals are rarely used except for quenching high-speed steels; however, low- and medium-temperature salt baths can be used, data for which are given in Table 5. Such baths for high-speed steels permit rapid cooling to the temperature of the hot bath and then employ a slower rate down to room temperature. Tools so quenched must be finally cooled below 200 F., and then drawn just the same as though they had been quenched in a more normal fashion.

Oils produce less distortion and less residual stress in steel; therefore, they are well adapted to complicated shapes and steels difficult to harden without cracking. They have a slower cooling rate than water or brine. Vegetable and animal oils are rendered gummy by the heat from hot metal and produce offensive odors. Mineral oils are generally used for quenching because of their lower cost and more stable nature.

In selecting an oil, several factors should be considered:

1. The oil must have proper cooling rates to produce the desired properties in the steel.

2. It must be reasonably stable.

3. It should be generally available and low in initial cost.

4. It should be chemically inactive with hot metal.

5. It should have a high flash point.

6. It should not change cooling rate appreciably with increased temperature.

7. It should not create a disagreeable odor when hot steels are immersed in it.

Oils for quenching tool steels should have a high flash point—about 350 F. or higher—to avoid unnecessary fire hazards. They should have a low viscosity so that it will circulate freely past the tools during quenching, and drain off when the tool is removed. The oil should not change composition by oxidization or as a result of heating so that its constant characteristic may remain unchanged. A non-emulsifying oil should be used; some oils take up water readily and cause many quenching difficulties.

Recommended temperatures for the quenching oils are 100–150 F. For uniform results keep the temperature of the bath within a range of 25 F., wherein the quenching rate will vary only one to two percent. Where large quantities of work must be handled, circulate the oil through cooling coils. A satisfactory arrangement, which serves most tool-hardening rooms is shown in one of the drawings.

In systems where the oil is not circulated, air is sometimes used for agitating purposes, but this is not recommended. Air may come in direct contact with the steel and cause soft spots. It should not be used in animal or vegetable oil baths, and is undesirable where compounded oils are used because of rapid oxidation.

The volume of the quenching medium to be used depends upon the size and the number of pieces to be quenched per hour and the method of cooling the bath. Where means are provided for cooling the bath, good practice is to use 15 lbs. of oil for each pound of steel quenched per hour; a ratio of less than ten to one should not be used. For uncooled baths, the ratio of oil to steel quenched per hour should be higher.

Quenching in oil tends to minimize distortion, but does not prevent it. When the degree of distortion produced by oil quenching is objectionable, recourse is taken to air hardening. The cooling rate in air is much lower than in oil or water. For still air quenching, it is best to suspend a tool or place it on a screen so that the air can circulate freely past it. Accelerated air cooling can be induced by fans or compressed air; however, in the latter case, extreme care should be exercised to remove all moisture from the compressed air line.

Relative cooling rates for quenching media are given in Table 8.

Unusual conditions often require special quenching media, such as a five to ten percent solution of sodium hydroxide in water which has a tendency to overcome some soft parts and non-uniformity of hardening in carbon tool steels. A mixture of water and glycerine in any proportion will produce a rate of cooling intermediate between oil and water. For oil-hardening steels, the glycerine content is comparatively high (60–90 per cent glycerine). Mercury can also be used to obtain local hardening.

Tools and dies should not be removed from the quenching bath until they are below 200 F., or to the point where water boils on them, neither should they be allowed to go cold in the quench. A good time to remove tools is when the surface is approximately 125–150 F. Then, if any mass is involved, hold this temperature until the tool becomes uniform in temperature throughout. This may be accomplished by placing in an oil bath for the required length of time. The tools are then ready for tempering.

TEMPERING

Tools should be tempered immediately after quenching and before they become cold, even though the tempering temperature is low. Recommended tempering temperatures for tool steels are given in Tables 6 and 9.

For temperatures between room and

Table 8—RELATIVE RATES OF QUENCH MEDIUMS

Quenching medium	Relative quenching rates: Still	At 3 ft. per sec.
Water	1.00	1.01
Brine:		
5 per cent sodium chloride	1.12	1.14
10 per cent sodium chloride	1.20	1.23
2½ per cent sodium hydroxide	1.19	....
5 per cent sodium hydroxide	1.17	1.20
5 per cent calcium chloride	1.06	....
10 per cent calcium chloride	1.17	....

	Still	Flash point, F.	Saybolt viscosity at 100 F.
Prepared oils [A]	0.35–0.45	365–375	110
Mineral oils:			
Transformer	0.17	311	75
Machine	0.22	405	250
Paraffin	0.29	327	...
Vegetable oils:			
Palm	0.15	435	220
Rapeseed	0.22	379	250
Castor	0.29	565	1500
Cottonseed	0.36	610	175
Olive	0.37	590	200
Lard oil	0.19	565	180–200
Fish oil	0.31	401	130
Sperm oil	0.33	500	110
Neatsfoot oil	0.33	500	230–270
Mixed oils:			
Pale neutral oil	0.26	360	65
Heavy residuum oil	0.29	534	1200
Mixture of both	0.32–0.42	...	....

[A] Mineral oil containing 3.3 per cent fatty acid.

Table 9—APPROXIMATE HEATING TIME FOR TEMPERING TOOL AND DIE STEELS [A]

Tempering temp., F.	Time in minutes per inch of diameter or thickness required to reach furnace temperature — In a hot-air oven, without circulation: Cubes or spheres	Squares or cylinders	Average flats	In a circulating air oven, or an oil bath [B]: Cubes or spheres	Squares or cylinders	Average flats
250	30	55	80	15	20	30
300	30	50	75	15	20	30
350	30	50	70	15	20	30
400	25	45	65	15	20	30
500	25	40	60	15	20	30
600	25	40	55	15	20	30
700	20	35	50	15	20	30
800	20	30	45	15	20	30
900 [C]	20	30	40	15	20	30

[A] These values apply to a dark or scaled surface on the tool. If the tool surface is finish ground or otherwise brightened, allow double the stated time in a still hot air oven. No extra allowance need be made for bright surfaces in a circulating oven or in an oil bath. Values based on maintaining constant tempering temperatures. Courtesy of Carpenter Steel Company.

[B] An oil bath can be used only at the lower temperatures.

[C] Temperatures above 900 F. are visible — watch the color.

NOTE: After the tool reaches the proper tempering temperature, it should be soaked at heat to allow internal changes to take place. Large or intricate tools should be soaked longer than small and simple ones; for the latter, 1 hr. is a nominal soaking time. As a general rule, the drawing temperature should be reduced 20–25 F. every time the soaking time is doubled after 1 hr. soaking; for example, the tempering temperatures for 2, 4 and 8 hr. soaking of a piece requiring soaking for 1 hr. at 300 F., will be 280, 260 and 240 F., respectively.

NOTE: The data in this table are given only as a guide in selecting the time to reach tempering temperatures.

600 F., a heavy high-flash oil can be used, data for which are given in Table 8. For temperatures between 450 and 1,050 F., molten salt can be used; typical mixtures and bath temperatures are given in Table 5. For higher ranges, molten lead can be used.

Time is as important a factor as temperature in drawing. An extra hour or so in the drawing bath may be all that is necessary to save a tool from breaking. Never economize on time at this stage of the work. If sufficient drawing equipment is not available to give each tool as much time as it should receive, more equipment should be provided.

Color drawing is no longer advocated, except in rare instances for carbon steels when treated by experience toolmakers. However, with the modern equipment available today for treating all types of tool steels, there is no excuse for not controlling tempering temperatures for carbon steels as well as alloy steels. Colors appear at different tempering temperatures in alloy steels, when compared to carbon steels; therefore they should not be used for the former. Also, there is no opportunity in color drawing to soak the steel at the drawing heat, which is so important on expensive tools. Exceptions might be tools hardened by a blacksmith or tools where local softening is desired.

The more common defects appearing during heat-treatment of tool steels are: (1) cracking, (2) warping, (3) soft spots, (4) size change, and (5) spalling. Data on preventing these are given in Table 10.

DISTORTION

When minimum distortion is required in a tool or die, select an oil- or air-hardening steel.

The faster the heat is removed during quenching, the greater is the inequality in cooling and the development of mass strains; this produces warpage and size change. Also, fast quenching is a contributing factor toward breakage when the pieces are straightened. Therefore, slow down the quenching speed so that sufficient hardness is maintained. This may be done by lowering the hardening temperature, reducing the amount of agitation in quenching, and by changing the types or viscosity of the fluid.

Distortion is often caused by gas liberated from the quench adhering to portions of the parts. This can be minimized by correctly agitating the sample or by flush quenching the part. Parts with sharp recesses should be quenched so that the gas is not trapped next to the part. If necessary, holes can be drilled to allow the escape of any trapped gas.

Long squares, cylinders, and flats should be entered end first. If entered on the long side, turbulence is set up causing the quenching medium to flow around the sides of the piece, and distortion will certainly occur. Flat round pieces should be entered at the periphery, rather than on the flat face, for the same reason.

Cylindrical pieces should be given a whirling motion. A simple way of doing this is to roll the cylindrical part down an incline pitched at 40 to 50 deg. Another method is to use a hardening cage provided with a small motor and a rotating mechanism; the cage should be rotating when immersed in the quenching medium.

Distortion of large pieces with thick and thin sections may be minimized by drilling extra holes in the thick sections. If there are holes in the thin sections, plug them with fire clay or asbestos whenever possible. Cover the thin sections with asbestos or paste. These are done to insure uniform quenching.

Thin parts may be die quenched to prevent distortion. The parts are held during the quench in rigid dies, and streams of quenching oil are forced by pressure into the dies.

Incorrect forging practice, such as the production of the wrong direction of grain flow, is often a cause of excessive distortion. Forgings with equi-axial fiber produce the best condition for minimizing movement

Table 10—PRECAUTIONS THAT PREVENT HEAT-TREATING TROUBLES

TO PREVENT CRACKING

1. Use care when placing cold steel in a high-heat furnace.
2. Bring the steel uniformly to temperature.
3. Avoid localized heating from direct impingement of the flame on the piece.
4. If overheated, cool in air to room temperature and proceed with the correct hardening treatment.
5. Preheats are frequently used with steels containing tungsten, chromium, vanadium and molybdenum.
6. Double preheats of 600 and 1200 F. are frequently used when hardening high-carbon high-chrome and hot-work steels.
7. Triple preheats of 600, 1200 and 1500–1600 F. are frequently used when hardening high-speed steels.
8. Temper immediately after hardening while the piece is still warm.
9. Don't rush temper drawing time — it promotes cracks, especially during grinding.
10. Prevent scale and gas pockets on the steel's surface.

TO PREVENT WARPAGE (SHAPE CHANGE)

11. Remove mill scale from all surfaces of the piece.
12. Heat slowly and uniformly; avoid localized heating; use preheats are noted in items 5, 6 and 7.
13. Sub-anneal after severe machining of annealed steels.
14. Rotate long, flat and cylindrical pieces during heating and quenching.
15. Use low temperatures for intricately shaped pieces.
16. Finish all surfaces alike before heating.
17. If warpage is great due to overheating, cool in air to room temperature and reheat properly.
18. Place properly in the furnace; heavy parts sag if not adequately supported. Don't stack pieces on top of each other.
19. Agitate or flush the piece during quenching to prevent formation of gas pockets and soft spots which contribute to warpage during tempering.
20. When quenching long, flat and cylindrical pieces, immerse them end first into the medium, or rotate them; see Item 14.

TO PREVENT SOFT SPOTS

21. Never use tap water, except for flush quenching.
22. Don't let the quenching bath get too hot.
23. Agitate the quenching bath, use flush quenching, or move the piece in the bath by rotating or moving up and down.
24. Use grasping tongs of small area; provide proper tongs for various classes of work.
25. Never allow parts to be in contact with adjacent parts, and walls of hearing pots, furnaces and quenching baths.

TO PREVENT SIZE CHANGE (GROWTH OR SHRINKAGE)

26. Be sure pyrometers record correct steel temperature.
27. Avoid overheating and under-heating. Use sample pieces to determine size-change characteristics of the steel.
28. Avoid excessive cooling rates on inner and outer surfaces, especially on intricate shapes.
29. Preheat and high heat carefully; observe items 2, 5, 6 and 7.
30. Before rehardening, give the piece a stress-relieving anneal.
31. Determine the right atmosphere for the job when using atmosphere-controlled furnaces; otherwise, excessive scale will form and cause size change.

caused by severe quenching strains.

A stress anneal after the rough machining operation on dies is beneficial in reducing warpage.

It is advisable to have all surfaces of the part finished alike. Parts rough machined on one side and ground on another produce an unbalanced condition in heating and subsequent cooling, and causes distortion.

Support pieces in the hardening furnace so that they don't sag under their own weight when hot. Objects of rigid design may not sag in this fashion, but may still be deformed if they are loaded in a furnace in such a way that they must support other materials. Distortion also may result from improper handling of the hot steel in removing it from the furnace or in quenching.

BREAKAGE

Parts requiring straightening should have generous fillets. Where a corner exists, there is always a concentration of stresses at this area when a deflecting load is applied to straighten the piece. This is especially true when a small diameter adjoins a large diameter. Frequently, the larger diameter with the softer center area will withstand the straightening load, whereas the smaller diameter which quenches harder and deflects more readily will not do so.

Inherently, coarse-grain steels are usually difficult to straighten, even when the carbon is low. This is not caused entirely by grain size, but the coarse-grained types are deeper hardening; therefore they are more brittle. As a general rule, the finer the grain size the less danger of breakage in straightening.

Oxidized or decarburized surfaces have a tendency to promote breakage, which is more pronounced in the higher carbon steels than the lower.

Sufficient time should be allowed at the hardening temperature to avoid quenching the steel before it is heated throughout. Parts so quenched will break under a slight straightening load.

When it is necessary to straighten tool steel, it is best performed on the descending heat. Straightening is done by heating, or bending in a vise or a suitable press with an adjustable control and knife-edge rest, so that if one load does not satisfactorily straighten the tool another load can be applied immediately. For straightening on the descending heat, the tool should be withdrawn from the bath at a temperature of from 500–600 F., which is just below the point where the oil seems to flash, or in the case of water-quenched tools, just where the water steams or dries off of the tools immediately.

Some steels are almost impossible to straighten after hardening; among these are the high-manganese oil-hardening types. These steels have deep hardening characteristics, become brittle and do not lose their brittle properties even when heated up to 1,000 F. Thus, they cannot safely be straightened. Fortunately, they quench out with well-balanced stresses and seldom distort from an oil quench. Steels of this type should be annealed, restraightened and rehardened if distortion occurs.

MACHINING TOOL AND DIE STEELS

Tool and die steels should be machined in the annealed condition, although medium hardened steel may be finished with cemented-carbide cutting tools. In the annealed state, all of these steels rarely exceed a hardness of 250 Brinell. Difficulties arise in machining these steels because the high carbon or alloy content makes them abrasive to the cutting tools. In the annealed state, they can be machined readily. However, at extreme hardnesses high-speed steel tools are not usually recommended. The machining of high-speed steels was discussed in a previous article (*AM*—Vol. 84, pp. 93–100).

Recommended speeds and feeds for other tool and die steels are given in Table II below. Cutting angles used on high-speed and cemented-carbide single-point tools are shown in the drawings. Surface finish on some heat-treated steels, machined with cemented-carbide or non-ferrous tools at high-speeds, is in some cases turned with sufficient precision that subsequent grinding is not neecssary.

Too low a hardness of these steels in the annealed state causes the ma-

Table 11—RECOMMENDED CUTTING SPEEDS AND FEEDS FOR ANNEALED TOOL STEELS*

Steels	Depth of cut, in.	High-speed steel				Stellite J-metal [4]				Cemented carbides	
		Feeds, in. per revolution									
		1/64	1/32	1/16	3/32	1/64	1/32	1/16	3/32	1/64	1/32
		Cutting speeds, surface ft. per min.									
Carbon and low-alloy water- or oil hardening steels	1/32	66–73	54–60	40–45	37–41	112–122	93–102	78–86	66–73	287–314	257–282
	1/16	59–65	49–54	38–42	33–37	100–110	85– 93	71–78	60–66	269–295	233–256
	1/8	50–56	41–46	33–37	29–33	88– 97	75– 82	61–68	52–58	245–269	208–229
	1/4	38–42	32–36	24–28	22–25	71– 78	60– 66	48–53	39–44	220–242	178–198
	1/2	27–29	22–25	19–21	12–14	51– 57	44– 49	35–39	28–31	164–180	155–170
Oil hardening, tough or hot-work steels	1/32	58–62	48–55	36–42	29–34	97–108	81– 90	69–76	58–66	238–270	212–242
	1/16	52–60	44–50	34–39	27–32	88–100	74– 85	63–72	53–61	223–254	191–219
	1/8	45–52	37–43	30–35	23–27	77– 88	66– 75	54–62	47–54	202–231	170–196
	1/4	34–39	29–34	23–27	18–21	63– 71	53– 61	43–49	35–41	181–207	145–167
	1/2	25–29	21–25	18–22	13–16	47– 53	40– 46	33–38	27–31	126–145	117–135
Air-hardening and high-carbon high-chrome steels	1/32	54–60	45–50	35–39	28–32	87– 97	74– 82	63–70	54–60	208–234	198–210
	1/16	48–54	41–46	33–37	26–30	79– 88	67– 75	57–64	49–55	196–220	170–190
	1/8	42–47	35–40	29–33	23–26	70– 64	60– 67	50–56	44–49	178–200	151–170
	1/4	33–37	28–32	23–26	17–20	57– 64	49– 55	40–50	34–38	160–180	129–146
	1/2	20–23	17–20	15–17	10–12	39– 44	34– 38	27–31	22–25	104–118	100–110

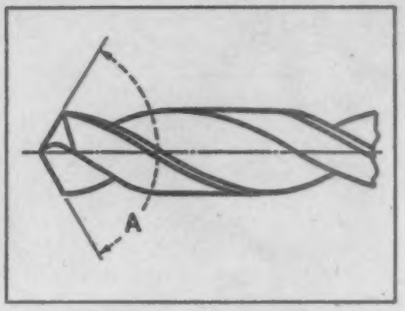
[4] With Stellite "2400" these speeds can be increased 25–30 per cent.
* Data are for continuous cutting with lubricant.

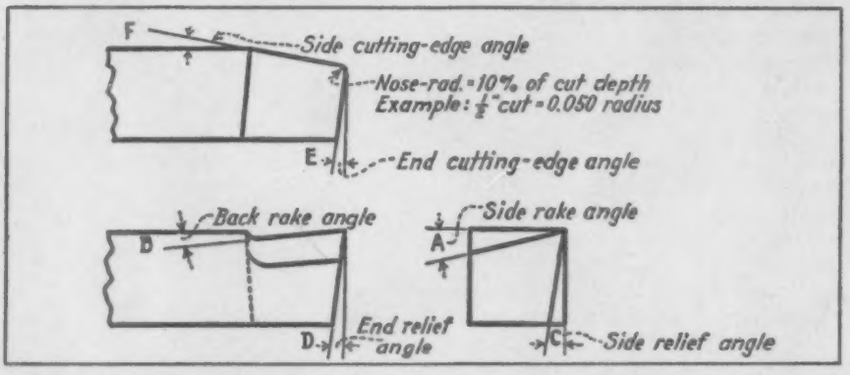
terial to become gummy and tear, and tools to dig in and break. Table 6 gives recommended hardnesses for the various types of steel, which hardnesses should produce satisfactory machining characteristics.

DRILLING

For hardnesses up to 350 Brinell, high-speed drills are satisfactory. Up to 200 Brinell, drills with point angles of 118 deg., and lip clearance angles of about 10 deg., operating at 60–110 ft. per min., are recommended. For Brinell hardnesses around 250, better results are obtained with drills having point angles of 130–140 deg. and lip clearance angles as low as 5 deg.

Around 300 Brinell, use a point angle of 130 deg., and operate the drills at 40 ft. per min. Drills with point angles of 130–150 deg. and operating at 20 ft. per min. are suitable for Brinell hardnesses of 350. When the Brinell hardness runs 400 and higher, the drills should be ground with a point angle of 150 deg., and run at a peripheral speed of 15 ft. per min.; they should have a heavy web structure, thin at the point and designed with a slower helix angle. For steels of 350–400 Brinell, cobalt high-speed or similar drills are preferred to high-speed drills.

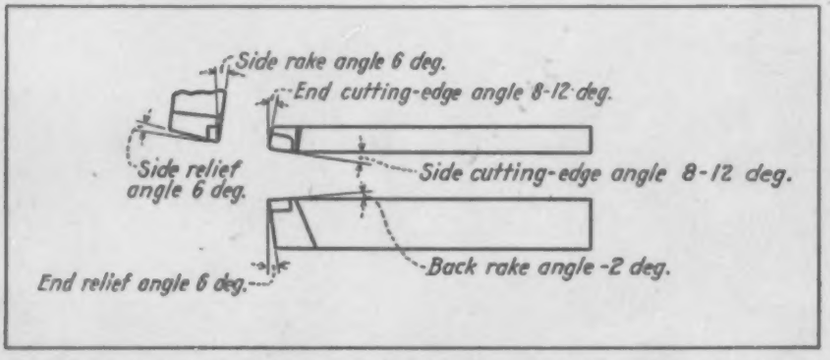




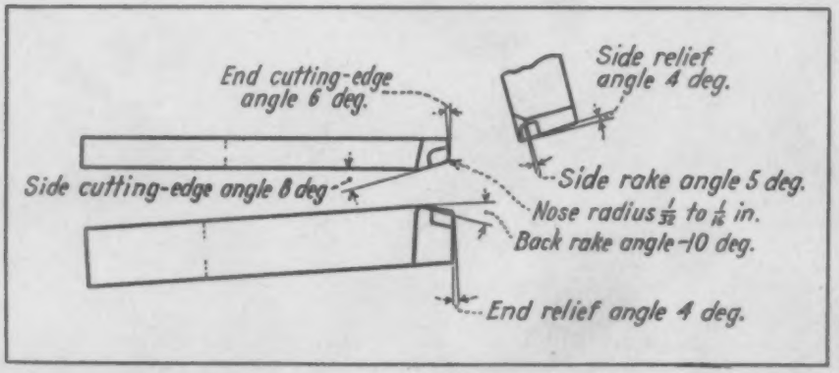
High-speed single-point tools for machining tool steels

Steel	Angles, deg. A	B	C	D	E	F
Carbon and low-alloy	20	5	6	3	10	10
Tough allow and hot-work	18	5	6	3	10	10
Air-hardening and high-carbon high chrome	16	3	6	3	10	10

NOTE: Use flood of coolant. Tools made from 18–4–1 high-speed steel.


Side rake angle 6 deg.
End cutting-edge angle 8-12 deg.
Side relief angle 6 deg.
Side cutting-edge angle 8-12 deg.
Back rake angle -2 deg.
End relief angle 6 deg.

Carbide-tipped tools can be used for turning annealed and hardened tool and die steels. Typical tool angles are shown


End cutting-edge angle 6 deg.
Side relief angle 4 deg.
Side cutting-edge angle 8 deg.
Side rake angle 5 deg.
Nose radius 1/32 to 1/16 in.
Back rake angle -10 deg.
End relief angle 4 deg.

Recommended angles are for carbide-tipped planing and shaping tools when machining annealed and hardened tool steels

Table 12—DRILL ANGLES, SPEEDS AND FEEDS

DRILL ANGLES AND SPEEDS

Steel hardness, Brinell	Point angle, A, deg.	Drill speed, peripheral ft. per min.
160–200	118	90–110 [A]
160–200	118	65– 75 [B]
160–200	118	60– 70 [C]
220–250	130–140	50 [D]
300	130–140	40 [D]
350	130–150	20 [D]
400	150	15 [D] [E]

DRILL FEEDS

Drill size, in.	Feeds, in. per revolution in steels of Brinell 160–200	220–300	350–400
1/8	0.0040	0.0025	0.0015
1/4	0.0070	0.0050	0.0025
1/2	0.0100	0.0075	0.0040
3/4	0.0130	0.0100	0.0060
1	0.0160	0.0120	0.0075

[A] For carbon and low-alloy steels.
[B] For tough and hot-work steels.
[C] For air-hardening and high-carbon high-chrome steels.
[D] For all the steels.
[E] Cobalt high-speed drills are recommended.

BROACHING

When internal broaching of spline holes, a cut per tooth of 0.004 to 0.005 in. is recommended, using broaches with shear-cut teeth set at 5 to 10-deg. shear angle. The former is used for high-carbon high-chrome steels, while the latter for carbon and low alloy steels. Also, use shear-cut teeth for surface broaching these steels; the cuts will vary from 0.0025 to 0.0035 in. per tooth, depending on the length, shape and size of the part.

A coolant is preferred to a lubricant when broaching. The latter have a

tendency to hold heat, and the broaches become overheated, causing expansion and increased sizes. This condition can be minimized by using a large volume of soluble oil.

MILLING

For the carbon and low-alloy steels, in the annealed state, cutting speeds of 60–70 surface ft. per min., and feeds of 0.007–0.010 in. per tooth, are commonly used. Finishing cuts can be made at 90–115 surface ft. per min. Recommended teeth angles are: end relief angle, 3–5 deg.; clearance angle, 10–15 deg.; rake angle, 10–15 deg. Milling cutters for these steels can have a land, usually $\frac{1}{32}$ in. wide. Sufficient clearance should be allowed behind the cutting edge to prevent rubbing, but should not be too great, otherwise the cutter will "hog in."

For milling the tough-alloy and high-carbon high-chrome steels, climb milling is generally preferred. Cutters have 8 to 10 deg. rake angle, 7 to 8 deg. clearance angle, 3 to 5 deg. and relief angle, and no land.

TAPPING AND THREADING

Only high-speed or better grade taps are recommended for tapping tool and die steels. Recommended peripheral speed for high-speed taps in the annealed carbon and low-alloy steels are 30–35 ft. per min., while for the tougher alloys and high-carbon high-chrome steels the speeds should be reduced to 20–25 ft. per min. In hardened steels, these speeds should be reduced 25–50 per cent, and copious amounts of cutting oil used. When taps of tougher materials than high-speed steel are used, the foregoing speeds can be increased at least 5 ft. per min.

For threading, milled-type chases usually require a 10-deg. angle hook for straight threads, and a 7-deg. angle hook for taper threads. Tapped form chases usually have a 15-deg. angle hook for straight threads, and a 10-deg. angle hook for tapered threads. Chasers for taps are ground with a 20-deg. lip hook for straight threads, and a 15-deg. radial hook for tapered threads.

It is imperative in threading these steels that the die head be given a proper and sufficient start in order to prevent cramping, tearing and taper threads. The chasers must be relatively hard, and it is preferable to order them to specifications that give the hardness of the steel to be threaded.

Table 13—CUTTING OILS FOR TOOL AND DIE STEELS

	Carbon and low-alloy steels	Tough-alloy and hot-work steels	High-carbon high-chrome steels
Grinding	50W+1 SO(F)	50W+1 SO(F)	50–75W+1 SO(F)
Cold sawing, high speed [4]	30W+1 SO	20W+1 SO	15–20W+1 SO
Cold sawing, slow speed [4]	SM(3)	SM(3)	SM(2–3)
	LM	LM	LM
	ML(2)	ML(2–3)	ML(3)
Drilling, bobbing, milling	15W+1 SO	10W+1 SO	.....
	SM(2–3)	SM(2–3)	SM(2–3)
	LM	LM	LM
	ML(2)	ML(2–3)	ML(3)
Turning, boring, planing and shaping	10–20W+1 SO	10–20W+1 SO	10–20W+1 SO
	SM(1–4)	SM(2–4)	SM(2–4)
	LM	LM	LM
	ML(2–4)	ML(3–4)	ML(3–4)
Reaming	10W+1 SO	10W+1 SO	10W+1 SO
	SM(1–3)	SM(2–4)	SM(3–4)
	LM	LM	LM
	ML(4)	ML(4)	ML(4)
Broaching,[5] roughing	15W+1 SO	10W+1 SO	10W+1 SO
	SM(2–3)	SM(3–4)	SM(3–4)
	LM	LM	LM
	ML(1–2)	ML(1–2)	ML(1–2)
Broaching,[5] finishing	SM(1–2)	SM(1–3)	SM(1–3)
	LM	LM	LM
	ML(2)	ML(2–3)	ML(3–4)
Threading and tapping	SM(2–4)	SM(2–4)	SM(2–4)

[4] For contour sawing, carbon tetrachloride is sometime used, in which case caution should be used since it is considered an industrial hazard.
[5] A coolant rather than a lubricant is preferred for broaching, since excessive heat is generated in this operation.
LEGEND:
W = Water.
SO = Soluble cutting oil.
SO(F) = Soluble cutting oil processed to free itself of grit and dirt.
SM = Sulphurized mineral oil.
LM = Straight mineral oil.
ML = Actual or processed mineral lard oil.
50W + 1 SO = 50 parts water plus 1 part soluble cutting oil.
Numbers in parentheses indicate the percentages of lard oil in the blend, and the cutting strength of the blend, No. 4 being the strongest.

Table 14—THREADING SPEEDS

Thread diam. in.	Surface ft. per min. for: Water- and oil-hardening, low- and tough-alloy steels		Air-hardening and high-carbon high chrome steels	
	NC	NF	NC	NF
¼	20	25	18	20
5/16	18	25	15	20
7/16	18	20	15	18
½	15	20	12	15
⅝	15	18	12	14
¾	12	15	10	12
1	12	15	10	12
1¼	12	15	10	12
1½	10	12	8	10

NC = National Coarse Threads.
NF = National Fine Threads.
NOTE: These speeds are for annealed stock only.

GRINDING

Surface Grinding—The abrasive must be sharp and free cutting, the grade of hardness in the soft range, and the structure open to avoid overheating and cracking the steel. The more wear resistant the steel, the softer must be the grade of the wheel.

When surfacing with the periphery of straight wheels, the wheel speed should be in the vicinity of 5,000 surface ft. per min., the vertical speed should be 0.0005–0.0010 in. per pass, table speed 20 to 30 ft. per min., and cross speed about $\frac{1}{3}$ in. per pass. Dry grinding is recommended in preference to wet grinding, since it has been found that less burning and discoloration occur than when grinding with a coolant. If a coolant is used, the supply must be generous and constant to prevent localized heating and possible checking and cracking.

In surfacing very hard steels, never use a soft wheel and run it excessively fast with a light in-feed in the hope of gaining fast stock removal without burning. This often results either in burnishing the surface or in excessive wheel wear without giving the desired stock removal. Experiment with moderate wheel speeds in such cases. Wheels above 12-in. in diameter usually take slightly coarser grits than 7x½x1¼-in. and the 10-in. sizes.

Cylindrical Grinding—Cylindrical grinding of dies is confined almost entirely to punches, both straight and tapered. The operation may be done wet or dry, on either a universal tool and cutter grinder or any small cylindrical machine. If wet grinding is employed, a copious supply of coolant must be used to avoid cracking and checking.

Internal Grinding—Internal grinding is employed on blanking and forming dies where accurate internal surfaces are required. Tool post grind-

Table 15—WHEELS, DISKS AND POINTS FOR GRINDING TOOL STEELS

	Abrasive type	Abrasive grit size	Grade	Bond	Wheel speed, surface ft. per min.
Hardened steel:					
Surface grinding:					
Straight wheels:					
To 12 in. (dry)...	Alum. ox.	46–60	Very soft	Vitrified	4500–6000
Over 12 in. (dry)..	Alum. ox.	36–50	Very soft	Vitrified	4500–6000
To 12 in. (wet)...	Alum. ox.	46–60	Soft	Vitrified	4500–6000
Over 12 in. (wet).	Alum. ox.	35–50	Soft	Vitrified	4500–6000
Cup wheels.....	Alum. ox.	30–36	Very soft	Vitrified	4500–5000
	Alum. ox.	30–46	Soft	Vitrified	4500–5000
Disks.....	Alum. ox.	30–50	Soft	Vitrified	4500–6000
	Alum. ox.	30–50	Soft	Resinoid	6000–7500
Annealed steel:					
Surface grinding:					
Straight wheels:					
To 12 in. diam....	Alum. ox.	36–60	Soft	Vitrified	4500–6000
Over 12 in. diam..	Alum. ox.	36–50	Soft or med.	Vitrified	4500–6000
Cup wheels.....	Alum. ox.	24–46	Soft	Vitrified	4500–5000
Disks.....	Alum. ox.	24–46	Soft	Vitrified	4500–6000
	Alum. ox.	24–46	Soft	Resinoid	4500–6000
Hardened and annealed steel:					
Cylindrical (dry).....	Alum. ox.	46–80	Soft	Vitrified	5000–6000
Cylindrical (wet).....	Alum. ox.	36–60	Soft	Vitrified	5000–6000
Internal.....	Alum. ox.	46–60	Soft	Vitrified	5000–6000
Portable tools: [4]					
Mounted wheels and points:					
Coarse.....	Alum. ox.	60	Med. or hard	Vitrified	To 25,000
Medium.....	Alum. ox.	90	Med. or hard	Vitrified	To 25,000
Fine.....	Alum. ox.	120	Med. or hard	Vitrified	To 25,000
Straight wheels.....	Alum. ox.	36–70	Hard	Vitrified	5000–6000
	Alum. ox.	36–70	Hard	Resinoid	7500–9500

[4] Internal grinding usually requires wheels of fine-grit, hard abrasive, vitrified bonded, so as not to affect the shape of the part being ground.

Table 16—RECOMMENDED BAND-SAW SPEEDS

Type of steel	Work thickness, in.	Saw teeth Set	Saw teeth Pitch	Saw velocity, ft. per min.	Feed pressure, lb.
Water- or oil-hardening low- and tough-alloys	¼ to 1	Raker	18–14	125–100	30–40
	1 to 2	Raker	14–10	100– 80	40–50
	2 to 3	Raker	10– 8	80– 60	40–50
	3 to 4	Raker	8– 6	60– 50	40–50
Air-hardening and high-carbon high-chrome steel	¼ to 1	Raker	18–14	100– 75	30
	1 to 2	Raker	14–10	75– 60	30–40
	2 to 3	Raker	10– 8	60– 50	30–40
	3 to 4	Raker	8– 6	50	40–50

ers or internal grinding attachments mounted on lathes are commonly used for internal work on large and heavy dies.

In internal grinding, the proper outline of the die must be maintained, which means that the grinding wheel must be hard enough to retain its shape.

Offhand Grinding—Mounted wheels and points in a great variety of sizes and shapes are used for miscellaneous offhand grinding on all kinds of blanking and drop forging dies. These are driven by light flexible shafts or motor-driven portable grinders. Choice of wheel specification depends largely upon the size and shape of the mounted wheel or point and the finish desired. The grinding wheel must be sufficiently hard to retain its shape and not affect the outline of the die.

Grinding wheel specifications are given in Table 15.

Die Sharpening—Sharp, clean stampings can be produced only with sharp dies and punches. If the punch and die are sharpened at the first signs of dullness, from 0.002 to 0.003 in. stock removal generally is sufficient to restore the sharp cutting edges. If the tools are used for a long time after they commence to dull, it may be necessary to remove as much as 0.015 in. or more from both the punch and die; therefore, it is economical practice to sharpen these tools at frequent intervals.

SAWING

A coolant is sometimes used when contour sawing tool and die steels to permit a higher saw velocity and faster cutting rate. Also, longer saw life is usually attained. Carbon tetrachloride is an excellent coolant when applied on the teeth as they enter the kerf. Some caution must be used with carbon tetrachloride as it sometimes is considered an industrial hazard. Another good coolant is soluble oil mixed with water.

A raker tooth saw (one tooth to the left, one tooth to the right, one straight tooth) should be used on tool and die steels. All steels should be in annealed condition. The cutting time and saw life will vary with the type of steel. As an average, it may be said that 1 in. thick oil-hardening steel can be sawed at a rate of 1 in. per min. with a saw life of approximately 50 ft. Air hardening and high-carbon high-chrome steels saw slower, and the saw life is less.

Table 16 gives data on contour sawing of these steels.

ENGRAVING

Free duplicating and engraving on and into tool and die steels is not always as simple as straight milling. The hardness of the steel is the first factor to consider in engraving these steels, and toughness the second.

In free duplicating, after the roughing operation has been completed, the work is usually forced into the cutter by means of levers, instead of screws, manipulating the table. This is especially true when the hardness is so high that it is impossible to proceed regardless of the size or shape of the cutter. This of course can be overcome by annealing.

MACHINE FILING

Speeds for machine filing usually run from 100 to 150 ft. per min., the higher speeds being used for annealed carbon and low alloy steels, while the lower speeds are used for the tough-alloy and high-carbon high-chrome steels. An average pressure of 20 to 40 lb. is considered satisfactory. A bastard-cut file should be used for all except finish filing, which requires a mill-cut type.

REAMING

Conventional expansion reamers can be used in reaming straight holes on the high-carbon and tough-alloy steels, and permit ease of set-up on machine arbors. Standard spiral or straight flute reamers can be used on the low-carbon low-alloy steels.

For taper holes, roughing reamers have a 15-deg. right-hand spiral, while for finishing a 28-deg. left-hand spiral with a very small land can be used. For machine reaming, generous supply of coolant must be used to produce a good finish.

Machining Zinc-Alloy Die Castings

Courtesy of The New Jersey Zinc Company

ZINC ALLOYS for die castings are comparatively soft (Brinell hardness from 57 to 113), and are free machining. High speeds and light cuts yield best results. Castings are produced very close to finished size, and the amount of metal which must be removed is generally small.

High-speed steels, Stellite and cemented-carbide tools can all be used. The latter two are recommended for long runs and where a high degree of accuracy and finish are required.

Most machining is done dry, but for particular work and most deep drilling and tapping a lubricant is recommended. Use half-and-half mixtures of lard oil and kerosene, or machine oil and kerosene; kerosene; light neutral oil; mixture of turpentine and kerosene for tough jobs; a mixture of one part soluble oil and ten parts of water for high-speed drilling and tapping. Never use soap, wax or tallow, except for drilling and tapping after parts are polished or plated, in which case oil will spoil the finish.

Drilling

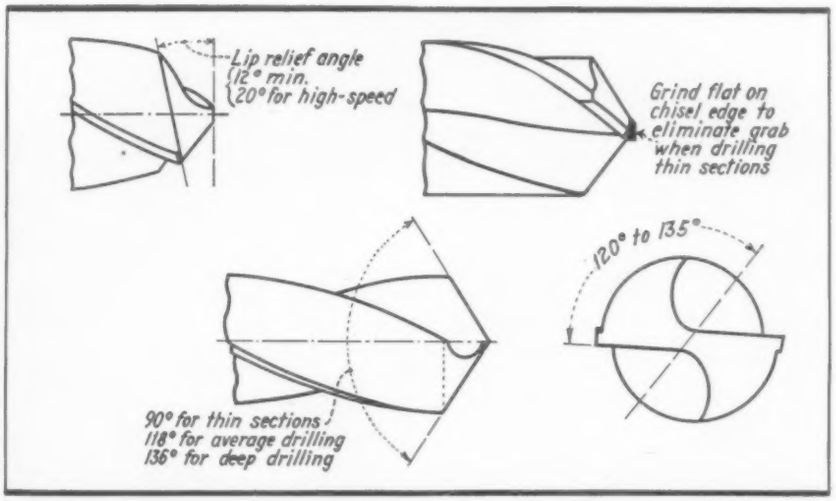
Type of Drill—Use carbon steels for shallow holes and high-speed drills for deep holes. All drills for this work should have large flutes and thin webs; if thick-webbed drills are used, they should be thinned near the point. Some plants use two-fluted drills up to $\frac{1}{4}$ in. diameter, three-fluted drills in $\frac{1}{4}$ to $\frac{3}{8}$ in. sizes, and four-fluted drills for all work above $\frac{3}{8}$ in.

Drill Angles—A 118-deg. point angle is recommended for general work. Increase it to 136 deg. for deep drilling to prevent run-out, especially on porous castings. A 90-deg. point angle will minimize burring when the drill breaks through thin sections; a narrow flat ground on the chisel edge will counteract the tendency of sharp-pointed drills to grab.

Speeds and Feeds—Use high speeds and low feeds; 200–300 and 100–150 surface ft. per min. for high-speed and carbon steel drills, respectively.

Tapping

Types—Pointed helical taps with 5 to 6 threads lead are recommended for through holes not more than two diameters deep. Use square-end straight-fluted taps with $1\frac{1}{2}$ to $2\frac{1}{2}$ threads lead for blind holes. Plenty of chip clearance is desirable; two-fluted taps for holes up to $\frac{3}{8}$ in. diameter and three-fluted ones for other sizes.


Lip relief angle
12° min.
20° for high-speed
Grind flat on chisel edge to eliminate grab when drilling thin sections
120° to 135°
90° for thin sections
118° for average drilling
136° for deep drilling

Drills for zinc-alloy die castings usually have a 118 deg. point angle and at least a 12 deg. lip relief angle; these can be modified as shown. A narrow flat face ground along the chisel edge gives zero rake and prevents the drill from pulling into the work

Self-tapping screws in small sizes are feasible with zinc alloy and may eliminate tapping operations.

For 1 in. and larger holes, adjustable or collapsible taps can be used when other types tear the threads as they are backed out of the hole.

Design—Use rake angles of 12 to 15 deg. and a hooked cutting face. Radial thread relief is recommended on large taps to reduce friction, prevent galling, and eliminate sticking when backing out of the hole. Radial thread relief can be effected on small taps by grinding off the back corner at the heel. Steep right-hand helical flutes sometimes prove of value, since they tend to carry chips out of the hole.

Threading

Types of Dies—Use button or acorn dies in small sizes, but on large sizes the chaser types are recommended. Straight milled chasers are most generally employed.

Design—Chasers may be of either the radial or tangent type. With radial chasers, use a 10 deg. radial hook for straight threads and 7 deg. hook for tapered threads. With tangent-type chasers, the cutting edge must be on or very near the center line of the part to avoid rapid wearing of the chasers just behind the cutting edge. A 5 deg. rake angle is recommended. For round dies, use a rake angle of 15 to 20 deg. with a narrow cutting section and eccentric or radial relief. Self-opening or solid adjustable dies are recommended for large threads.

Speeds—For radial chasers use 50, 100 and 200 surface ft. per min. for $3\frac{1}{2}$–$7\frac{1}{2}$, 8–11 and 12–32 threads per inch, respectively. For other threading, speeds 15 to 10 percent slower than tapping speeds are recommended.

For very small threads, speed-nuts of spring steel which cut their own threads can be used to eliminate threading the castings.

Reaming

Type of Reamer—Use straight six- or eight-fluted reamers, except for holes with keyways where helical-fluted reamers must be used. For deep holes, both right-hand reamers and left-hand helical types cutting right-hand give

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Machining Zinc-Alloy Die Castings

good results. Rose reamers are not recommended. Stepped reamers can be used on co-axially stepped holes. For large holes, inserted-blade reamers are preferred; the blades can be shaped to perform a facing operation at the bottom of the hole, as well as size the hole itself.

Design—The reamers should have deep flutes, which should be polished to avoid loading. The faces of the flutes are usually made radial (zero rake), but a 10-deg. clearance angle back of the land is recommended. The land should be not more than 0.015 in. wide, but this is often reduced to 0.007 or 0.005 in. to obtain freer cutting.

If $\frac{1}{32}$ in. or more metal is to be removed, it is sometimes recommended that the reamer be ground with a stepped portion at the end, about 0.005 in. smaller than the body of the reamer. The bevel at the end of the reamer flutes should be 45 deg. In grinding the lead bevel, a 10-deg. clearance angle is advocated.

Turning

High-speed steel, Stellite and cemented carbides are used almost exclusively for turning zinc-alloy die castings. Recommended cutting tool angles are given in the table. Generally, the tool is set horizontally or slightly below the center line of the work. Frequently, however, the cutting tool is set about $\frac{1}{4}$ in. above the center of the piece and tilted downward at 15 deg.

Milling and Spot-Facing

Special cutters with coarse teeth are best, but stock cutters can be used if sufficient relief is used, usually about 10 deg. Use rake angles of 10–15 deg. on all cutters. Staggered-tooth cutters are recommended for deep slots; a similar effect can be obtained with non-staggered types by nicking or chamfering the corners of alternate teeth.

In spot-facing bosses, a tool with an odd-number of teeth (usually seven), zero rake and 12 deg. clearance behind the cutting edge is recommended. For large work, inserted blade cutters are used; these are frequently cemented-carbide inserts. In removing heavy flash, the cutting face of the tool is often turned 15 to 20 deg. to the work.

Broaching and Shaving

Any standard broaching machine can be used for finishing die castings, but punch presses and other machines are often adapted to the job. Usually, the castings have but 0.004 to 0.006 in. of metal left for removal. Holes can be broached to extremely exact sizes, and if burnishing lands follow the cutting lands, the surface of the parts can be burnished to a high finish.

Shaving dies commonly have straight lands about $\frac{1}{8}$ in. wide to permit grinding the face without changing the size, but are relieved below this point.

Sawing

Sawing is sometime performed in removing sprues or gates, but is an infrequent operation on the casting itself. Band, circular or jig saws are employed. Use saws with 7 to 10 teeth per inch; on thin sections the number can be increased. The speed of circular or band saws should be 2,000–3,000 ft. per min. Jig-saw speeds are 250–300 strokes per min.

Grinding and Polishing

Fins and excess surface metal on zinc-alloy castings can be removed by grinding. Surfaces can be smoothed by polishing preparatory to plating. Most grinding is done dry or with a waxed wheel, but for precision grinding a liquid lubricant may be used. For rough grinding, No. 60 grit resinoid-bonded wheels without perforations and lubricated by application of wax to the wheels are recommended. For a smoother finish, No. 100 grit resinoid-bonded wheels are the types most frequently advocated.

Disks loaded with Nos. 60, 100, 120, 150 and 180 grits are used for finished flat surfaces or edges of die casting. When finer grits are used, a preliminary and coarser grinding operation on the casting is often required when much metal is to be removed. Felt or canvas wheels with the abrasive glued to the periphery are used for polishing large, complex and irregular-shaped castings preliminary to plating. No. 180 aluminous abrasive is glued to the wheels for coarse grinding and No. 240 abrasive for finishing. Surface speeds recommended are 5,000–6,000 ft. per min.

Other Operations

Swaging—Swaging improves tensile strength of the part, up to a reduction in area of 40 percent. It should be done cold, but not below 70 F.

Riveting—Rivets are generally cast integral with one part of two mating die castings, and are readily headed over; however, riveting should not be done at temperatures below 70 F.

Punching—When punching holes in thin sections, the castings must be supported by the lower die. When punching fins from cored holes, the hole itself may be used as the lower die; punch toward the large end of the hole.

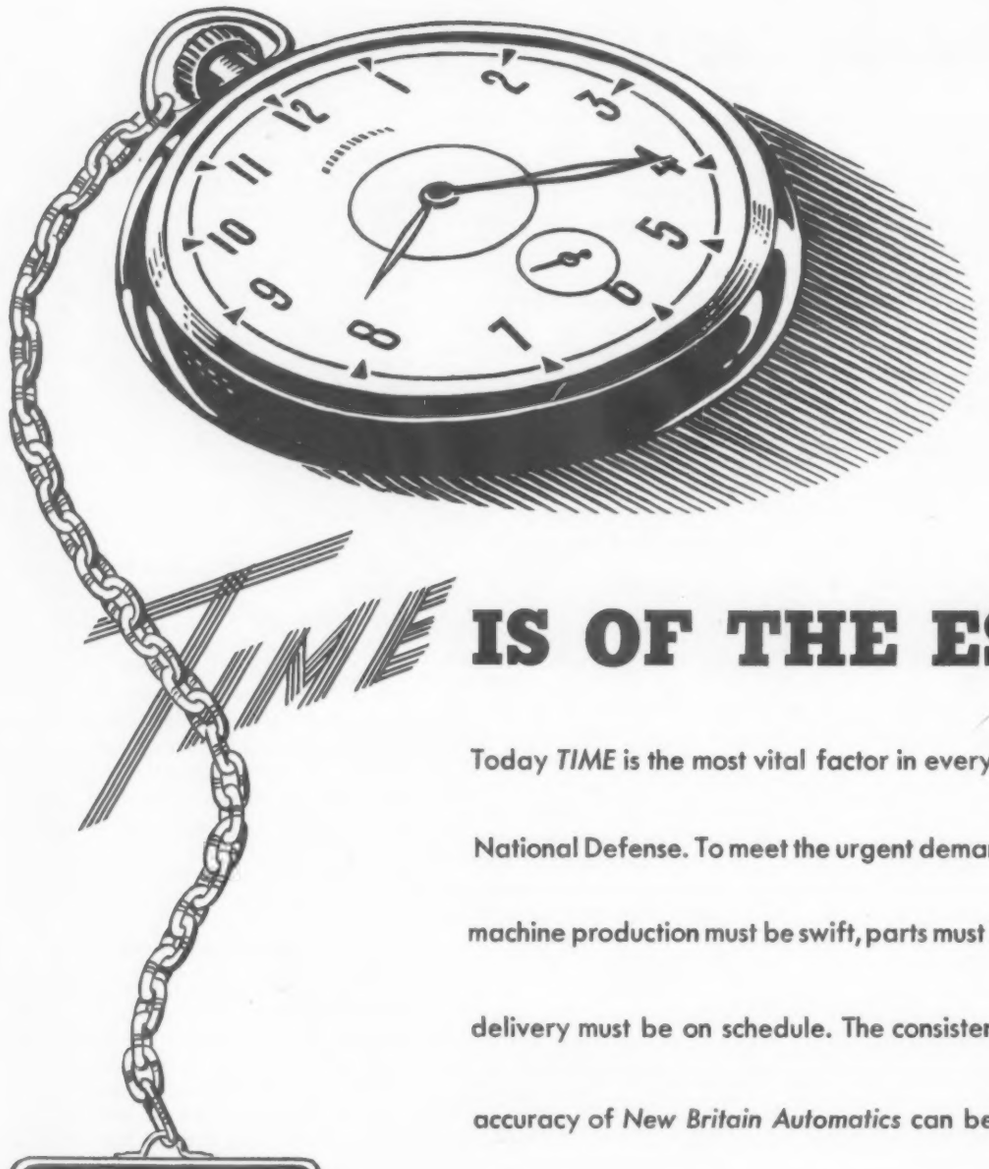
Bending and Forming—Bending and forming projecting parts of zinc-alloy die castings, which cannot be conveniently cast to desired shape, can be bent or formed after casting. Mild heating may help to render the metal more ductile, but is seldom required. Do not bend or form these castings below 70 F.

RECOMMENDED CUTTING TOOL ANGLES

Angle	Carbon or high-speed steel and Stellite	Cemented-carbide tools
Back rake	0–20 deg.	5–10 deg.
Side rake	10–20 deg.	5–15 deg.
End relief	8–20 deg.	6– 8 deg.
Side relief	4 deg. min.	4– 8 deg.
End cutting edge	8–15 deg.	5–10 deg.
Side cutting edge	10–20 deg.	10–20 deg.*

* Side cutting edge angle not important, and can be as much as 45 deg.

IN NATIONAL DEFENSE



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GAGING BUSINESS

Metal-working industry is in favorable position to expand production to offer aid to Britain. Some 30,000 companies have prime contracts for defense production; 70,000 have subcontracts

Since the worst of the tooling-up job for defense will be over within the next sixty to ninety days the metal-working industry is in a favorable position to expand production with reasonable speed to offer greater aid to Britain. At present some 30,000 companies have prime contracts for defense production and 70,000 firms possess subcontracts. A substantial percentage of these 100,000 companies are in the metal-working field.

Machine Tools—Machine-tool builders expect that a new buying program running into several hundred million dollars will come out of the aid-to-Britain plans now being formulated in Washington. Such a program will have to be superimposed on business now on the industry's books, which alone will keep operations at full capacity for months ahead. Lately, however, the industry is doing better than in many months in meeting delivery dates with a minimum of delay. One government action which is helping to speed machine-tool production is the placing of so-called "float orders" which enable an individual manufacturer to turn out a sizable number of one size and kind of machine. Various defense agencies and private contractors with defense orders can then draw upon the pooled equipment for machines needed for a particular project. British and American "float orders" are reported to exceed $75,000,000 and will rise a much higher level soon. It is understood that British purchases of machine tools will shortly be taken over completely by the Machine Tool Division of OPM. The New York office of the British Purchasing Commission will be continued and will have as its main function the buying of miscellaneous goods for the British Government. The pressure on machine-tool builders to furnish machines to the airplane and shipbuilding industries is still terrific and may result in deliveries being pushed back a bit to companies with strictly ordnance manufacturing contracts. It should be said, however, that the priority system of delivering machines to the critical points where they are most needed is beginning to function more smoothly. Machine-tool companies have lengthened their work weeks further and are in the process of enlarging their factories beyond the capacity contemplated when the defense program started.

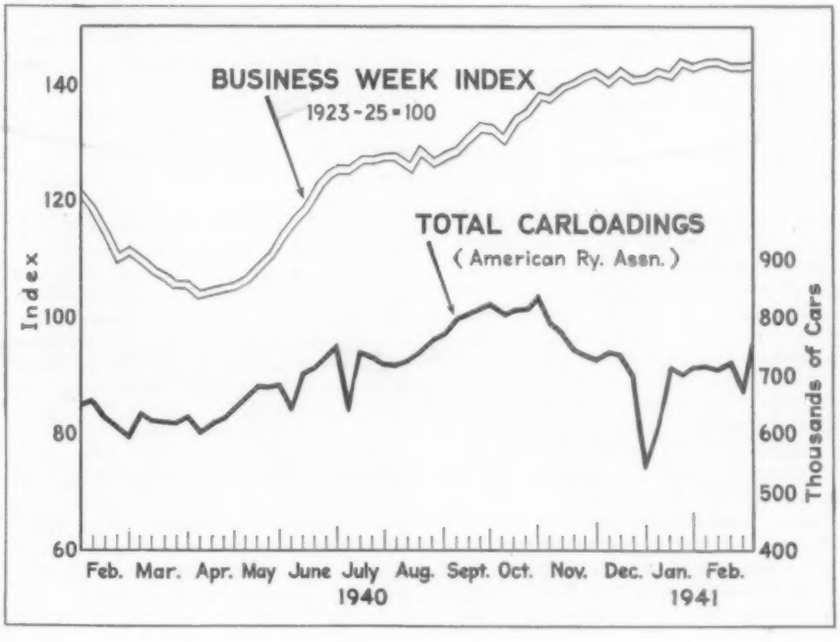
Shipbuilding—Congress is expected to authorize construction of 200,000 tons of additional auxiliary craft for the Navy. They would include tenders, sweepers, tugs and mine layers, which might be used to bolster weak spots in the British Navy. About 50 new ships will be represented by this new tonnage. Rapid progress is being made on building the seven new yards for 200 emergency ships for the British. A large shipbuilding company is reported converting passenger liners to troop transports capable of moving large bodies of soldiers at great speed. Contracts for shipbuilding in Great Lakes yards total around $90,000,000.

Railroad Equipment—Two hundred locomotives, 19,763 freight cars and 125 passenger cars were contracted for in the first two months of 1941. That is the largest volume for a similar period since 1929. Southern Pacific will spend $20,000,000 for 50 steam locomotives and 2,500 freight cars. Pere Marquette has ordered 500 freight cars. Mainline, terminal and yard capacity has been built up by the carriers to meet the defense emergency.

Steel—Steel mill operations have reached an all-time high and will continue without interruption there for months. Buying is still far outstripping production, though bookings have tapered a bit. No priorities are contemplated, although the industry is taking pains to see that defense contractors are served ahead of all other customers. The Gano Dunn report, which says that the country's steel-making capacity is sufficient, has not ended the agitation for expansion by New Dealers. Just how much additional steel will be required by the new aid-to-Britain program is not yet known. Automobile companies have been heavy purchasers of steel.

Munitions—Some 30,000 companies now are prime contractors for the government in the defense program. The number of prime contracts let are estimated at 46,000. At least 70,000 companies are engaged on subcontract work. Production of ordnance items is proceeding at a satisfactory rate, with a considerable step-up contemplated in late Spring. Some $1,750,000,000 of the $7,000,000,000 asked of Congress by the President for British aid will go for ordnance materiel. Worthington Pump has received an order for $4,718,400 for artillery items to be made at its Holyoke, Mass., factory. York Safe & Lock has an additional order for artillery materiel amounting to $2,969,476. Rheem Mfg. Co., Chicago, will furnish bomb practice bodies totaling $3,051,657.

Farm Equipment—The War Department is reported negotiating with Deere & Company for manufacture of tank gears and transmission parts to cost $18,000,000. A shortage of farm help and continued good farm income are holding farm equipment sales at a better rate than last year. Exports for January of $4,961,000 were 46 per cent higher than last year because of shipment abroad of about $4,000,000 of wheeled tractors. Strikes still are in progress at four International Harvester plants, affecting manufacture of two small farm tractors and other implements and holding up Government contracts for heavy tractors.



U. S. Production for Defense is Discussed At Cleveland Army-Navy-ASME Meeting

CLEVELAND—That American industry already possesses a fund of experience in manufacturing national defense material was evident to 500 persons attending the Third Army & Navy Meeting on National Defense, held in Cleveland March 12-13. Sponsoring organizations were the Army Ordnance Association and the American Society of Mechanical Engineers. Sessions were devoted to manufacture of tanks, ammunition and aviation parts, also gaging practices, training industrial personnel and subcontracting.

After presentation of slides by Frederick A. Stevenson, vice president in charge of operations, American Car & Foundry Co., on manufacture of light tanks, it was brought out that armor plate is now "foolproof" in manufacturing processes, and can be welded if desired. Tests of the relative efficiencies of welding versus riveting armor plate are considered confidential by the Army. Some armor-plate sections are being flame-hardened, but the extent and depth of such treatment depends upon the vulnerability of the tank part to the various types of projectiles.

Tanks, in the opinion of Lt. Col. John K. Christmas of the Aberdeen Proving Grounds, have demonstrated their worth in land warfare as the most economical use of money, material and men. An armored division consists of 250 12-ton tanks, 120 30-ton tanks and several hundred special military vehicles, all weighing about 8,500 tons and costing about $15,000,000, or about the same as a cruiser. Although only 32 tanks were built in the 1919-1935 period, the 12-ton model has been adequately developed and several other designs can be depended upon to equal or surpass foreign equipment.

Urges Use of Old Machinery

George T. Trundle, Jr., president, Trundle Engineering Co., urged manufacturers not to think that all defense jobs must be done on the latest-type machinery. The job of rearmament is too big to be handled in that manner and time is important. Mr. Trundle and others spoke of reconditioning present machine tools, breaking jobs down into simple elements, using general purpose machines now available and employing more secondary operations as a means of getting out production long before special-purpose or automatic machinery can be secured from equipment builders.

Suggestions were made that the government change its specifications for shell forgings to permit "commercial limits," which might save 20 per cent of material and considerable machining. Army spokesmen indicated that huge new shell programs would shortly be forthcoming. In that event, costs will be reduced and time of equipment saved, if shell forgers are also made responsible for rough machining, it was stated.

Arvid Nelson, factory manager, Hamilton Standard Propellers Div., United Aircraft, showed the results of planning for accelerated production. Steps involved: (1) standardization on one group of material specifications suitable for any use, (2) fixing of work standards, such as finish, (3) drawing supervisory personnel from the ranks to reduce training time, and creation of an organization chart for 117 supervisory jobs, (4) purchase of second-hand, quickly delivered equipment adequate for short-term use, (5) functional shop layout, including conveyors, (6) sub-contracting (7) use of a specific schedule of manufacture for each new increase in load, involving decisions of purchasing, sub-contracting, machine loadings, new equipment procurement schedules, and training programs. Preplanning in this fashion during the last two years has permitted an increase in production of 143 per cent, while productive labor increased 121 per cent and floorspace only 19 per cent. Costs have decreased.

Discusses Shell Turning

Max Kronenberg of the Cincinnati Milling Machine Co. presented a method for coordinating speed, feed, depth of cut, horsepower, tool and tool life for maximum shell production. The "Shell Machining Chart" presented was offered as a basis for exchange of experience in shell turning.

C. F. Hood, president, American Steel and Wire, indicated that, with proper distribution of expanded steel production, the needs of national defense and exports to Britain can be handled. Industry needs advice on the kind, quantity and delivery dates required for war materials.

Tell Berna urged manufacturers to use every means to acquaint the public with the incredible amount of manufacturing processes required to support mechanized war.

S. B. Terry, Pratt & Whitney, described various types of gages, comparators, and measuring devices and the order of accuracy obtainable with them. Few gage makers are available but present training programs and the new directions in requirements for defense may alleviate the worst features in certain bottlenecks.

Fay Aller, Sheffield Gage Corp., described new multi-check electric comparators which will double output in shell inspection. Engineers present at the meeting urged industry to go ahead with munitions projects although gage makers will not be able to supply the needed inspection equipment for months.

SPUR SUBCONTRACTING DRIVE

WASHINGTON—Plans are on foot to put some dollar pressure as well as patriotic appeals behind the subcontracting drive. Not yet in effect, the idea is to weigh favorably the bids of firms which agree to subcontract specific parts of the work, thus presumably speeding delivery. Also contemplated is letting of contracts practically on a brokerage basis in which the prime contractor, essentially, sells responsibility for the job, and lets out most of the actual work. He'd still have to do some of the work to avoid trouble with the law which prohibits assignment of government contracts. This is not to be confused with the recently amended law forbidding assignment of government claims.

Attempt to Standardize U.S.-Anglo War Equipment

WASHINGTON—Attempts to standardize war equipment among the armed services of the U. S. and Britain are being intensified in anticipation of the "single-order" system of defense production which the Administration has set as one of its goals under the lend-lease program. Current efforts are being directed toward airplanes, ordnance, tanks and technical instruments. A large number of groups in the Army, Navy, OPM, and the industries involved have been working toward standardization for some time; Roosevelt is expected to coordinate their efforts.

U. S. plane manufacturers have been divided into Eastern and Western divisions, and at a meeting recently called by the OPM the standardization problem was divided into seven major parts and an engineering group put to work on each. It is emphasized that production might be speeded up and the problem of field maintenance and repair diminished. A Joint Army-Navy British Standards Committee has charge of complete units and types.

Differences between the Army and Navy over types, designs, parts, etc., are being ironed out rapidly.

LATE DEFENSE CONTRACTS

WASHINGTON — Allis-Chalmers Mfg. Co., La Porte, Ind., has been awarded $5,120,229 for artillery materiel. Other contracts are: Bossert Co., Utica, N. Y., $1,290,000, and Norris Stamping and Mfg. Co., Los Angeles, $690,000 for cartridge cases; Harley-Davidson, Milwaukee, Wis., $870,360, and Indian Motorcycle, Springfield, Mass., $857,000, for motorcycles; International Harvester Co., Chicago, $932,400, adapters; and Hobart Bros. Co., Troy, N. Y., $2,491,320, generating units.

CERTIFICATES OF NECESSITY

WASHINGTON—Simplification of the application forms for Certificates of Necessity has speeded up their issuance to the point where OPM is nearly current on applications. As we go to press some 720 certificates have been issued, while applications are pending on 996 others. These certificates, testifying that a new plant facility is required in the interests of defense, must be obtained on any facilities on five-year amortization for tax purposes. They must be applied for within sixty days of acquiring or starting construction of the new plant.

Lift Export Licenses For Britain and Ireland

WASHINGTON—Red tape of shipments to Britain has been reduced by a ruling which, in effect, removes the requirement that a license be obtained for exports to Great Britain and Northern Ireland of a long list of commodities, including most light machine tools. A similar arrangement has been in effect for some time on most shipments to Canada. Among the articles on which licenses were previously required but which are now included in the so-called "general license" for Britain are:

Pipe threading machines; metal cutting band saws; power driven hack saws; keyseating machines; disk grinding machines; car wheel and locomotive wheel presses; gear burring, chamfering, and burnishing machines; crank planers; bench power presses; saw sharpening machines; filing machines; pipe bending machines; thread chaser grinders; burnishing, riveting, and grinding machines; centering machines; arbor presses; nibbling machines; lathe and tool grinders; gear lapping and shaving machines; polishing machines; heat treating furnaces; twist and other drills; reamers; milling cutters; hobs; taps; dies and die heads; shear knives; abrasives and abrasive products containing emery, corundum, or garnet, as well as abrasive paper and cloth; measuring machines; gauges; testing machines; balancing machines; hydraulic pumps; and tools incorporating industrial diamonds.

General license No. GDG 2 should be shown on the shipper's export declaration, covering exportations made under this order.

WHITESIDE TO AID OPM

WASHINGTON—Bartley Whiteside, supervisor of training, Wright Aeronautical Corp., Paterson, N. J., has been appointed "training - within - industry" consultant for OPM by Sidney Hillman.

International Machine Tool Corporation May Offer Stock to Public; Plan Expansion

ELKHART, IND.—As a part of a general program to expand the activities of International Machine Tool Corp. arrangements are now under way for a public offering of the shares of the concern. International Machine Tool Corp., which represents an amalgamation of the Foster Machine Tool Co., and International Machine Tool Co., Indianapolis, was organized in December 1940.

C. Russell Feldman, who with E. H. Welker of Detroit, purchased a controlling interest in the corporation, is the president and treasurer. Feldman was one of the pioneers in the development of the automobile radio industry, having served as president, Transitone Automobile Radio Corp. Mr. Welker, who has been elected executive vice president and a director of the concern, has represented machine tool companies for the past 25 years.

International Machine Tool Corp. will sell stock now held in its treasury in order to finance part of the expansion program. In order to allow a broader public participation in the ownership of the business, heretofore privately owned, stockholders have agreed to sell a portion of their holdings. Upon completion of the public offering, it is expected that application will be made to list the stock on the New York Exchange.

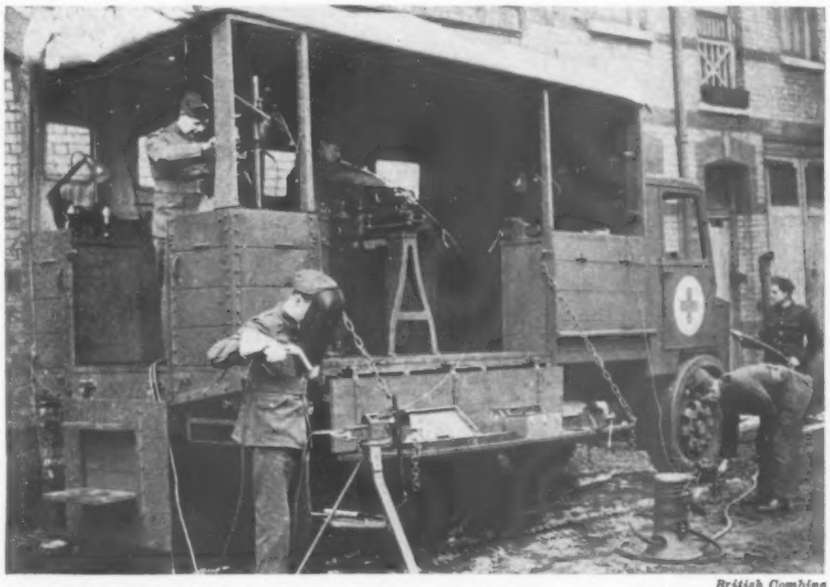
The corporation which is engaged in the production of machine tools for both domestic use and the export market is licensed to manufacture superfinish machines under patents owned by the Chrysler Corp. The company is also a leading producer of other machine tools such as turret lathes and automatic chucking lathes.

Arrangements have been completed to open a New York office in the Chrysler Building to handle sales of the concern.

W. H. Foster, formerly president, Foster Machine Co., is now chairman of the board, International Machine Tool Corp. E. J. Terry, formerly vice president, International Machine Tool Co., Indianapolis, is vice president and general manager of the new corporation. George M. Sundheim, formerly of the Indianapolis concern, has been named a director of the new company.

MOBILIZE U. S. LABOR

WASHINGTON—Mobilization of national manpower resources to speed production of defense goods began last week with a country-wide registration of workers at state employment offices. All unemployed workers who may be available for work or training in defense jobs, and all who have needed skills which they are not using in their present jobs, have been urged to register. It is expected that 1,500,000 persons will respond to the call and permit their systematic transfer to defense activities. It is likely that the program will discourage the useless migration of workers from one part of the country to another on wild "hunches" that jobs are available.



British Combine

Workshop On Wheels—*A completely equipped mobile workshop (above) has been presented to the Red Cross. The shop carries its own lathe and small tools, makes its own current, and is capable of repairing automobiles, ambulances, and small vehicles.*

Most of Canada's War Production Meets Schedule; Aircraft, Machine Tools Delayed

MONTREAL—Production schedules are being met in seven of the ten divisions of Canada's armament program. The branches of War industries which are meeting or exceeding expectations include: general equipment for the military services, constructions, ship-building, motor transport, explosives, shells, alloy and steel production.

Meanwhile aircraft production is about three months behind schedule. The slack is being taken up, however, and in a few months it is expected that output will be up to schedule or beyond. Tank production is about two months late. Production of small tools and gages has become a serious problem; Canadian plants are about two months late on deliveries. Although the government plans to double, perhaps treble, present facilities, Canadian armament production is, until this time, dependent on U. S. tools.

The chief problem has been the machine tool supply. Canadian plants have been providing about 20 per cent of the country's requirements; the U. S. has been looked to for 80 per cent. Seventy per cent of the machine tools ordered in Canada for delivery on December 31, 1940 were delivered; the other 30 per cent have been deferred to this year.

Design Changes

A contributing factor to the delay in airplane construction has been the policy of making constant improvements and changes in various types of planes. There also has been delay in receiving plans and parts from Britain. Contracts placed to date with Canadian aircraft companies total approximately $100,000,000.

Some 14 types of guns and 10 types of mountings are now being produced in Canada. The Bren gun plant is stepping up production to 97,500 guns per year, making it the largest producing automatic gun plant in the world. An additional plant, which will get into production next year, will raise productive capacity to 147,500 automatic guns annually. In comparison no plant in the U. S. produces more than 25,000 automatic guns annually.

The Canadian Department of Munitions and Supply has awarded contracts which total $1,024,695,321 during the period from July 14, 1939, to November 30, 1940.

Industrialists on Canada's west coast indicate that there is room for tremendous expansion in the shipbuilding and metal-working industries. Some companies are operating at only about 30 per cent capacity. At the same time, however, the government has indicated that many manufacturing districts in Western Canada are characterized by inadequate housing facilities, and has, therefore, hesitated to grant contracts to industries in those areas. Remedial action has already been taken in the form of a government-owned company, War-Time Housing Ltd., which will build $100,000,000 of housing accommodations for war workers.

The following contracts have recently been let by the government:

Aircraft, Fairchild Aircraft Ltd., Longueuil, Que., $202,698; and Canadian Westinghouse Co. Ltd., Hamilton, $449,826. Shipbuilding, Davie Shipbuilding and Repairing Co. Ltd., Montreal, $3,303,000; Marine Industries Ltd., Montreal, $2,208,000; Vivian Engine Works and Reliance Motor Machine Works, $3,800,000.

Industry Not Greatly Affected by Lend-Lease

WASHINGTON—Lend-lease will not have anything like as big an effect on U. S. industry as might at first be assumed. Do not be misled into considering the seven billion appropriation for Britain as a net addition to the ten billion or so of orders now placed. For some time it has been true that the limit on the armament program is not the amount of money available but the physical capacity of the munitions industries. Thus the only goods which will be available to lease-loan to Britain are the goods which are already being delivered under existing U. S. orders.

The need of large new appropriations arises from the clause in the British aid act limiting to $1,300,000,000 the amount which may be given from goods now on hand or appropriated for. Much of this allowance will be used up in shipping armament now on hand. So in order to deliver current production to Britain, new duplicating orders must be placed. Then, as goods come off the line, deliveries on the original orders are deferred, and the goods are accepted on the new order for Britain. In effect, the program has not been increased so much as extended farther into the future.

Of course, there will be some expansion of capacity—as there would have been British aid or no. The item of $750,000,000 for new plant capacity is apparently a net addition to the $750,000,000 already budgeted for the purpose. Though even here the real limit on activity is the capacity of the equipment suppliers. Some part doubtless of the appropriations for ordnance, planes and the like will be used to buy the output of these new plants, but this can hardly be a very large part because plants started now can hardly be in substantial production before twelve or eighteen months.

ZONE CANADA'S INDUSTRY

OTTAWA—In order to harness all possible industrial resources to war needs, the Dominion is now being organized into industrial zones with a chairman and a committee for each zone who will work in direct conjunction with the Department of Munition and Supply. The purpose of the zones is to collect and to maintain current industrial information and to advise the government thereon if requested. The entire organization work is being carried out by the Canadian Manufacturers' Association and the Canadian Chamber of Commerce with the approval and support of the government. One of the chief aims of the survey to be completed is to attempt to learn how far the Dominion can go in the utilization of existing plants, both directly and as subcontractors for other firms.

Used Machinery Dealers Form An Association

CHICAGO — Temporary organization was established in Chicago on March 4 to make plans for a permanent association of used machinery dealers of the middle west with 32 firms represented, including some from Minneapolis, Milwaukee, and Rockford. The association has been formed in order to make possible effective and efficient cooperation with the priorities board in Washington; and that the group have adequate representation at meetings held in Washington and that a central office be established to act as a clearing house for information for used machinery firms. The latter is particularly needed for collection of data from the various manufacturers on prices of all machinery upon which depends the allowable sale price of the used models.

Officers selected to serve for a 90-day period are: Harold Blumberg, of Adams Machinery Co., president; Sam Danits of Louis E. Emerman & Co., and Al Gellman of Interstate Machinery Co., vice-presidents; Max Segal of Segal Machinery Co., treasurer, and Thomas P. Scanlan of Surplus Record, secretary. The following were elected as the Washington committee: Paul Frankson, Donahue Steel Products Co.; Louis Emerman; Al Gellman; Carl Moser, Jr. of Milwaukee and Harold Blumberg.

NEW AIRCRAFT PLANT

CHICAGO—Goodyear Aircraft Corp., a subsidiary of Goodyear Tire & Rubber Co., will start construction soon on a new plant to build wings and fuselages for Martin bombers. The new plant will employ about 5,000 people.

INSIDE DETROIT

February passenger sales experience abnormal upswing; production rise unlikely. Thirty-five G.M. plants have war contracts which total 683 million; an additional 100 million is being negotiated

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—February's abnormal upswing in passenger car sales indicates that seasonal influences are now playing a subordinate part in the retail market. More money in circulation, fears of higher automobile prices and taxes, determination to buy now while possibly the greatest value is available are factors influencing the public. Some automotive men feel that the rush to buy will blow itself out by midspring, while others are not concerned because they believe that the industry must maintain capacity assembly operations until the end of the model run.

General Motors' report for February indicates the trend. Sales to dealers in the U. S. for January were 218,578 units; in February 208,214 because of fewer working days. Actual retail sales to consumers in January were 168,168, but in February they soared to 187,252, which surpasses any month in 1940. Thus, production by G.M. divisions in February was 30 per cent ahead of the comparable period a year ago, while retail sales advanced 52 per cent.

Production Rise Unlikely

A rise in production to keep pace with the abnormal increase in retail demand is not considered likely by automotive observers familiar with current plant operations. They cite the fact that the more prominent manufacturers are operating at capacity. It is believed that motor-car plants will operate at peak levels until the end of the model season, instead of slackening somewhat in May and more in June.

Production by U. S. plants totaled 500,931 units in January, and the preliminary estimate for February is 475,000 units. The drop was occasioned by fewer working days in the latter month plus the effect of labor troubles. March and April should probably exceed the 500,000 mark unless strikes such as that at Midland Steel Products (a frame maker) cause curtailment of assemblies.

Thirty-five General Motors plants are now manufacturing or preparing to produce war materials for the U. S., British and Canadian governments. In the short interval of four months, contracts accepted by the Corporation have jumped from $400,000,000 to $683,400,000. Other contracts in the negotiation stage approximate an additional $100,000,000.

Orders received by affiliated organizations are not lumped into the $683,400,000 figure. Yellow Truck & Coach has orders approximating $100,000,000; Bendix and North American account for another $300,000,000.

Deliveries of special defense materials in the last few months of 1940 reached $60,000,000 in value, or approximately 3 1/3 per cent of total General Motors sales volume for the year. Net income on such business, before federal taxes, was 1.5 per cent of the corporation's net income for the year.

Analysis of the $618,200,000 worth of contracts to be handled in the U. S. discloses that 57 per cent is earmarked for airplane engines, bomber parts and miscellaneous airplane equipment, 14.5 per cent for diesel engines, 10 per cent for trucks, 10 per cent for machine guns, 2.5 per cent for shells, cartridge cases and fuses, and 6 per cent for miscellaneous items. Expressed in another way, internal combustion engines figure exclusively or are involved in at least 70 per cent of total dollar volume of present contracts held directly by the corporation.

The breakdown of present contracts by type follows:

Trucks. Over 100,000 have been ordered. Contracts last fall totaled $20,000,000, have jumped since to $62,500,000. Plant expansions have been made at the Pontiac plant.

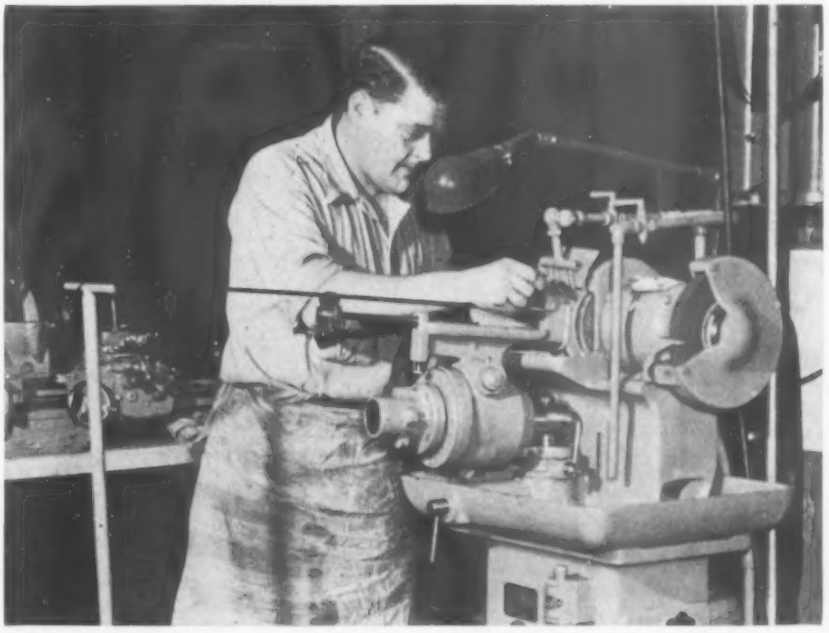
Canada. Orders placed with G.M. plants in Canada have grown slightly in the last four months, now totaling $65,200,000.

Shells, Cartridge Cases, and Fuses. Production orders in the amount of $16,600,000 now stand on the corporation's books. Oldsmobile will commence manufacture of 75- and 105-mm. shell in May. Chevrolet has completed an educational shell order and has been purchasing machinery, evidently with production shell orders in mind. Guide Lamp recently completed a new building for cartridge case production and is gearing facilities to handle extensive production as soon as the first order is out of the way. Delco Products is preparing to make fuses.

Guns. A $61,400,000 contract for approximately 70,000 machine guns in 30-

MARINE ENGINES

DETROIT—With passage of the lend-lease legislation, the British are expected to make immediate demands for Packard marine engines in much larger quantities. These engines are needed for expansion of the so-called "mosquito" torpedo-boat fleet, with which the British will harry invasion forces and enemy shipping. It would not be surprising to see Packard's orders to date more than doubled in the near future.



Tools For Defense—*General Motors is setting up four plants for the manufacture of machine guns. Each plant is scheduled to produce 100 guns per day; barrel production may reach a new high. An operator (above) at the Saginaw Steering Gear plant is sharpening a gun barrel drill*

SEE DEFENSE CHANGES

WASHINGTON—Some important changes in the defense set-up are expected soon by many observers. Three staffs and OPM all report to the President through the Office of Efficiency Management. There is no indication as yet that the Office of Emergency Management will become the control board of all activities, with a new man to head it. Until the going gets too heavy the President may continue to be the actual head of the program. Some change that would give him relief of direct responsibility seems entirely likely.

and 50-cal. sizes and in five types, has been allocated to four divisions—Saginaw Steering Gear, AC Spark Plug, Frigidaire and Guide Lamp. An additional $20,000,000 was allocated to equip these plants, which are scheduled to reach a maximum production of 100 guns each per day by end of year.

Negotiations have not been completed whereby Pontiac will make a Swiss 20-mm. anti-aircraft gun for the British. Trade circles understand that these guns are badly wanted for protection of convoys against dive-bomber attack. Approximately $5,000,000 worth of equipment will be needed for this enterprise, which is considered more difficult than making the machine gun. Some machinery is already in storage for this job, and machinery people believe that the British Purchasing Commission could rapidly supply the remainder from its machinery pool, so that production might commence in the spring of 1942.

Diesel Engines. New orders for marine propulsion machinery have swelled orders possessed by the Cleveland Diesel Engine Div. from $46,400,000 to $29,400,000 in four months.

Airplane Equipment. Orders for airplane controls and instruments are unchanged at $7,000,000, and will be produced with re-arranged facilities at the Rochester Products Division.

Miscellaneous Equipment. Orders for miscellaneous items are now at $37,300,000, little changed from four months ago. These include: fire control equipment such as made at the Delco Appliance Division, Rochester, landing gears, electrical equipment, tank-gun mounts and items of a confidential nature.

Airplane Engines. Production of airplane engines falls into two classifications. Allison, at last reports, had orders from the British and American governments for $190,100,000 worth of the liquid-cooled engine in the 1,000-hp. classification. A 2,000-hp. model is not yet ready for production. Acknowledged orders for Allisons have increased $26,000,000 in four months. Present output is 350 per month, with 1,000 per month scheduled for early fall when new plant additions are placed in operation.

U. S. Government Contracts Awarded to Metal-Working Firms

(Does not include contracts under $100,000)

Source	Agency	Commodity	Amount
American Hardware Corp., New Britain, Conn.	War	Fuse parts	$114,495
Smith Bros. Mfg. Co., Pindlay, Ohio	War	Shell	128,384
National Tube Co., McKeesport, Pa.	War	Forgings	3,580,199
Bridgeport Thermostat Co., Bridgeport, Conn.	War	Practice bombs	217,728
Edward G. Budd Mfg. Co., Philadelphia, Pa.	War	Parts for bombs	3,409,338
Warren Webster & Co., Camden, N. J.	War	Booster parts	663,000
Bethlehem Steel Co., Bethlehem, Pa.	War	Forgings	1,420,000
Sharpsville Steel Fabricators, Inc., Sharpsville, Pa.	War	Tanks	373,200
Allegheny Ludlum Steel Corp., Brackenridge, Pa.	Navy	Steel	145,740
Norris Stamping & Mfg. Co., Los Angeles, Calif.	Navy	Ammunition boxes	664,240
Cushman Motor Works, Lincoln, Nebr.	War	Fuse parts	582,000
Michigan Tool Co., Detroit, Mich.	Navy	Worm gear units	436,680
Reed-Prentice Corp., Worcester, Mass.	Treas.	Lathes	105,810
The Peck, Stow & Wilcox Co., Southington, Conn.	Treas.	Metal-working machinery	115,470
South Bend Lathe Works, South Bend, Ind.	War	Lathes	330,244
Standard Machinery Co., Providence, R. I.	War	Bearings	141,120
Bendix Aviation Corp., Eclipse Aviation Division, Bendix, N. J.	War	Generators	222,852
H. K. Porter Co., Inc., Pittsburgh, Pa.	War	Chemical shells	475,408
Consolidated Machine Tool Corp., Rochester, N. Y.	Navy	Milling machines	184,704
Kingston Products Corp., Kokomo, Indiana	War	Shell	381,000
The Hobart Bros. Co., Troy, Ohio	War	Welding outfits	185,000
Yellow Truck & Coach Mfg. Co., Gen. Motors Truck & Coach Div., Pontiac, Mich.	War	Trucks and chassis	2,507,263
Republic Aviation Corp., Long Island, N. Y.	War	Airplane parts	16,275,657
Lavine Gear Co., Milwaukee, Wis.	War	Trailers	703,500
Bendix Aviation Corp., Bendix Products Div., South Bend, Ind.	War	Wheel & brake assys.	260,100
Continental Motors Corp., Detroit, Mich.	War	Engines	10,715,019
General Motors Corp., Buick Motor Div., Detroit, Mich.	War	"	36,497,520
General Electric Co., Schenectady, N. Y.	War	Superchargers	19,040,429
Bendix Aviation Corp., Pioneer Instr. Div., Bendix, N. J.	War	Indicator assys.	3,186,315
Bristol Yacht Building Co., South Bristol, Maine.	Navy	Minesweepers	300,000
Square D. Co., Kollsman Instr. Div., Elmhurst, N. Y.	War	Altimeter assys.	2,745,985
Bendix Aviation Corp., Pioneer Instr. Div., Bendix, N. J.	War	Drift meters	1,942,560
John A. Roebling's Sons. Co., Trenton, N. J.	Navy	Jackstays	186,161
Maine Steel, Inc., South Portland, Maine	Navy	Shackles, clamps	174,883
Eastern Rolling Mill Co., Colgate, Md.	War	Ammunition	1,960,000
Republic Steel Corp., Buffalo, N. Y.	War	Blanks	246,642
Republic Steel Corp., Cleveland, Ohio	War	"	140,149
Leathem Smith Coal & Shipbuilding Co., Sturgeon Bay, Wis.	Navy	Hull and fittings	600,000
National Tube Co., McKeesport, Pa.	Navy	Flasks	228,347
Greenville Steel Car Co., Greenville, Pa.	Navy	Buoys	425,085
Revere Copper & Brass, Inc., Rome, N. Y.	War	Cartridge cups	167,976
The Buda Co., Harvey, Ill.	Navy	Diesel engine parts	121,280
Denison Engineering Co., Columbus, Ohio	War	Test stand	425,000
Yale & Towne Mfg. Co., Stamford, Conn.	War	Pumps	191,688
Atwater Mfg. Co., Plantsville, Conn.	War	Fuse plugs	118,125
Bogue Electric Co., Paterson, N. J.	Navy	Motor generators	159,000
United Engineering & Foundry Co., Pittsburgh, Pa.	Navy	Forging press	1,972,182
The Buda Co., Harvey, Ill.	Navy	Generator sets	421,680
Industrial Brownhoist Corp., Bay City, Mich.	War	Crane	450,460
American Hoist & Derrick Co., St. Paul, Minn.	War	"	418,000
Lakeside Bridge & Steel Co., Milwaukee, Wis.	TVA	"	129,150
Sandy Hill Iron & Brass Works, Hudson Falls, N. Y.	Navy	Winches	146,828
Ingersoll-Rand Co., Painted Post, N. Y.	Navy	Compressors	160,560
National Acme Co., Cleveland, Ohio	War	Screw machines	1,971,330
Scovill Mfg. Co., Waterbury, Conn.	War	Fuse parts	4,231,240
Standard Steel Works, N. Kansas City, Mo.	War	Tank trailers	941,554
Star Electric Motor Co., Bloomfield, N. J.	Navy	Control motors	106,000
A. J. Miller Auto Cruiser Trailer Co., Inc., Bradenton, Florida	War	Trailers	495,046
International Harvester Co., Washington, D. C.	War	Trucks	676,076
Yellow Truck & Coach Mfg. Co. (Gen. Motors Truck & Coach Div.), Pontiac, Mich.	War	"	63,925,772
Gibbs Gas Engine Co. of Florida, Jacksonville, Fla.	Navy	Minesweepers	640,000
Mine Safety Appliance Co., Pittsburgh, Pa.	Navy	Submarine escape app.	525,018
Bendix Aviation Corp., Pioneer Inst. Div. Bendix, N. J.	War	Indicator assys.	308,000
Weston Electrical Inst. Corp., Newark, N. J.	War	"	1,516,412
Kearney & Trecker Corp., Milwaukee, Wis.	Navy	Milling machines	118,101
Triumph Explosives, Inc., Elkton, Md.	War	Artillery ammunition components	202,950
Morton Mfg. Co., Chicago, Ill.	War	Ammunition chests	321,079
R. C. A. Mfg. Co., Inc., Camden, N. J.	War	Tubes	104,453
Tophams, Inc., Washington, D. C.	War	Chests	112,050
Fate-Root-Heath Co., Plymouth, Ohio	War	Locomotives	125,250
Davenport Besler Corp., Davenport, Iowa	War	"	125,250
W. E. Shipley Machinery Co., Philadelphia, Pa.	War	Grinders	198,956
Murray Manufacturing Corp., Brooklyn, N. Y.	War	Artillery ammunition components	142,680
Speeden Shipbuilding Co., Inc., Baltimore, Md.	War	Diesel-propelled box boats	267,500
Dubuque Boat & Boiler Works, Dubuque, Iowa.	War	" "	265,000
Luders Marine Const. Co., Stamford, Conn.	War	" "	306,960
Allen Boat Co., Gretna, La.	War	" "	204,500
Calumet Shipyard & Drydock Co., Chicago, Ill.	War	" "	212,000
Sturgeon Bay Shipbuilding & Drydock Co., Sturgeon Bay, Wis.	War	" "	214,000
National Acme Co., Cleveland, Ohio	War	Machines	1,971,330
American Brass Co., Waterbury, Conn.	War	Small arms	1,353,708
Chase Brass and Copper Co., Inc., Waterbury, Conn.	War	Brass	547,018
Revere Brass and Copper Co., Baltimore, Md.	War	"	1,579,540
General Motors Corp., Chev. Div., Washington, D. C.	War	Trucks	8,296,493
Diamond T. Motor Car Co., Washington, D. C.	War	"	737,154
Lavine Gear Co., Milwaukee, Wis.	War	Trailers	703,500
Fruehauff Trailer Co., Kansas City, Mo.	War	"	4,465,040
Goodyear Tire & Rubber Co., Akron, Ohio	War	Wheel and brake assemblies	923,504

WATCHING WASHINGTON

Whether remedies offered so far can solve labor's jurisdictional disputes is doubted by Administration. Mediation seen as best bet. Agreement reported near in West Coast shipbuilding industry

By BLAINE STUBBLEFIELD

WASHINGTON—The New Deal and its war agencies are beginning to sweat cold over labor's jurisdictional disputes and its determined drive for more money and closed shops. From the President down they are doubtful about all the remedies that have been proposed. The leaders have been hiding behind a curtain of silence on this the most critical of all problems facing the defense effort. Showdown day is coming closer.

Jurisdictional disputes, especially, nettle the government, because they are the result of the CIO-AFL labor war which, it is now admitted, should have been settled at all costs before we took on a shooting war. This trouble is new to American war psychology; we didn't have it in 1918. Hillman states publicly that disputes must be stopped, and voluntarily he believes.

Propose forms of Mediation

Several forms of mediation have been proposed in bills before Congress. Sec. of War Patterson and OPM Director General Knudsen approved of a mediation agency in principle. Knudsen favored: (1) notice of intent to strike in a defense industry only after a secret ballot at the plant, conducted by the U. S. Conciliation Service (2) an OPM fact finding committee to study the dispute for ten days and make a report; (3) the strike would be deferred for 30-day cool-off period, during which efforts toward a settlement would be made; (4) failure to settle would result in forefeiture by the union and the manufacturer of their rights before the NLRB.

It is questionable right now whether any mediation agency will be set up by legislation. As American Machinist reported (AM—Vol85,page182i) the House Judiciary Committee hearings on anti-strike bills are being staged as a form of threat to labor; no immediate action is expected. But it seems clear that a mediation agency could be set up under executive authority, without legislation. It probably will be done, one way or the other.

Even so, the President's advisers are dubious about mediation. For one reason, if it's not purely voluntary it's not mediation, and if it's purely voluntary it doesn't get results. For another thing, mediation is not secret as is conciliation. It's public; it sets precedents. Let it make a concession to labor or management, and everybody wants more of the same.

But some advisers to the President believe mediation will work if it uses publicity as a cudgel. They go so far as to say it is the only democratic method that will work. Usually, one party to a dispute is wrong; maybe both parties are wrong. If so, they can't stand in the spotlight against public opinion. American Machinist is told on good authority that some of the current unsettleable disputes are pretty dirty, and that if the public knew the facts, they would be settled promptly. Even if both sides are right, and are merely bickering, they can't stand too much publicity. Of course, it is a matter of opinion what is wrong. From one point of view a demand for closed shop is a crime; from another, it is a noble objective.

To the War Department, any strike, however little or brief, is an obstruction not to be condoned. Yet the Department says it is leaving the whole problem to OPM, which was created to take the responsibility for the supply of defense goods. Secretary Patterson spoke up on strikes, but he was called upon by Congress to do so. The War Department did intervene in the Wright Field strike at Dayton "because the situation was vital and inexcusable." Not long ago an Army officer participated in Vultee strike negotiations, but spokesmen say he was not authorized to do so. The department's policy in strikes is hands off. But since the War Office is the last refuge of public safety, it cannot promise that it will not intervene in strikes. For if all else failed to produce weapons, an executive order to the Army would be the inevitable move.

Harris & Ewing

Expediter—*W. Averell Harriman, who relinquished his duties in the OPM, is now in London as liaison man with the British in handling American war aid. He has assumed the post of special expediter*

Mr. Hillman and President Roosevelt point out that strikes are relatively few; the President says that only one fourth of one per cent of defense production is affected at any one time. And of those few the Labor Department's Conciliation Service, headed by Dr. John Steelman, is settling 98 per cent. But this picture is not as good as it looks. Some of those few strikes recoil through the entire defense program. They disturb the confidence of the government and the public in the soundness of the defense effort. Some labor executives who display the most confidence, admit privately that a few strikes in vital spots might paralyze a large section of essential industry.

West Coast Agreement Near

Meanwhile, on the West Coast a significant and possibly precedental agreement was reported near completion in the shipbuilding industry. It is said to place a ceiling on wages and probably covers other conditions. AFL, which has most of the Coast ship unions, would not give detail as this was written. It was believed that parties to the deal were the unions, contractors, the OPM, the Maritime Commission, and possibly the Navy. Mr. Hillman said that similar deals might be made in the Gulf and Atlantic coast regions; Great Lakes is not in the present picture. Aircraft might follow next, either by regions or as an industry. The regional agreement should be watched; OPM believes it may be the solution to many of its labor problems.

The government's attitude toward strikes appears inconsistent economically, if not politically. The President himself is determined that prices shall not rise, but while he wants an end to jurisdictional disputes, he says nothing about demands for higher wages, which must show up in the form of higher prices. And if profits are cut, to pay wages, there won't be anything left to tax to run the defense effort. Maybe that doesn't matter; there's no limit now on the national debt.

A general steel strike, or a general coal strike, could not be allowed to happen. But what measures might be necessary to prevent them is what worries the Administration. You have one fairly reliable guide in making your guess as to the future. President Roosevelt is forgetting. his forgotten man, and his mind is almost entirely occupied with beating the Axis.

Chain Belt President

J. C. MERWIN

New Vice Presidents at Carpenter Steel Co.

ERNEST J. POOLE, JR.

FRANK R. PALMER

Bullard's Manager

FOSTER P. WHITWORTH

NAMES in the NEWS

Howard P. DeVilbiss and Roy A. Guyer have been elected vice presidents, DeVilbiss Co., Toledo. Mr. DeVilbiss is the son of the late Thomas A. DeVilbiss, who conceived and developed the company's industrial division. Mr. Guyer, sales manager, spray painting division, has been with the company for 29 years.

Dr. Tracy C. Jarrett, formerly assistant metallurgist with American Optical Co., has been appointed chief metallurgist, Koppers Co., American Hammered Piston Ring Division, Baltimore, Md.

S. J. McDowell has joined the engineering staff and will have charge of production, American Lava Corp., Chattanooga, Tenn.

J. C. Merwin, former vice president and treasurer, was elected president, Chain Belt Co., Milwaukee. Mr. Merwin has been associated with the company since 1917 and has been successively superintendent, works manager, assistant to president, director, vice president and treasurer, and finally president.

Ernest J. Poole, Jr., former general superintendent, has been named vice president in charge of manufacture, and Frank R. Palmer, former assistant to the president, has been appointed vice president in charge of sales, Carpenter Steel Co. Mr. Poole is the son of the late E. J. Poole, Sr., who was formerly vice president and general manager of the company. Mr. Palmer has been affiliated with the company since 1917.

Charles C. Ramsden, who has served 27 years as consulting engineer, has been elected vice president, Beloit Iron Works, Beloit, Wis.

Clarence B. Tilton has been elected vice president in charge of production, Safety Grinding Wheel & Machine Co., Springfield, Ohio.

Foster P. Whitworth has been named works manager, The Bullard Co., Bridgeport, Conn. Mr. Whitworth first became associated with the Bullard Co. in 1896, at which time he signed up as an apprentice.

PLANT EXPANSION

Aluminum Company of America, Fairfield, Conn., has acquired four idle units of Crane Co., Bridgeport, embracing 350,000 sq.ft. of floor space.

Borg-Warner Corp., Chicago, has begun an expansion at its spring division plant at an estimated cost of $300,000.

Carboloy Co. Inc., Detroit, has been expanding its new plant in order to triple its carbide metal production capacity. Approximately 23,000 sq.ft. of additional floor space will be added under the program.

Douglas Aircraft Co. Inc., Santa Monica, Calif., is erecting a new corrugated iron assembly building at a cost of $60,000.

D. A. Stuart Oil Co., Chicago, is providing an additional 3,000 ft. of manufacturing space at a cost of $50,000.

Peck Spring Co., Plainville, Conn., will build a 20x80 ft. addition to its screw machine department.

OBITUARIES

George B. Ingersoll, 73, former assistant manager, Fairbanks, Morse & Co., Beloit, Wis., died recently. He was with the company for 31 years.

William Murchey, 82, retired inventor and founder of the Murchey Machine & Tool Co., of Detroit, Mich., died recently in Los Angeles.

Howard Ashley Pedrick, 78, believed to have invented more portable machine tools than any other man, died recently. His inventions brought him more than 50 patents. In 1913, with his daughter, he established the machine shop of Pedrick & Ayer, Woodstown, N. J.

William B. Updegraff, Watson-Stillman Co., Roselle, N. J., an inventor of several mechanical engineering devices, died recently. He installed the first marine turbine built in America.

MEETINGS

American Gear Manufacturers Association. Annual convention. Hot Springs, Va., the Homestead, May 5–7.

American Iron and Steel Institute. Annual meeting. Waldorf-Astoria, New York, N. Y., May 22.

American Society for Metals, Western Metal Congress and Exposition. Pan-Pacific Auditorium, Los Angeles, Cal., May 19–23.

American Society of Mechanical Engineers. Spring meeting. Atlanta, Ga., April 1–3.

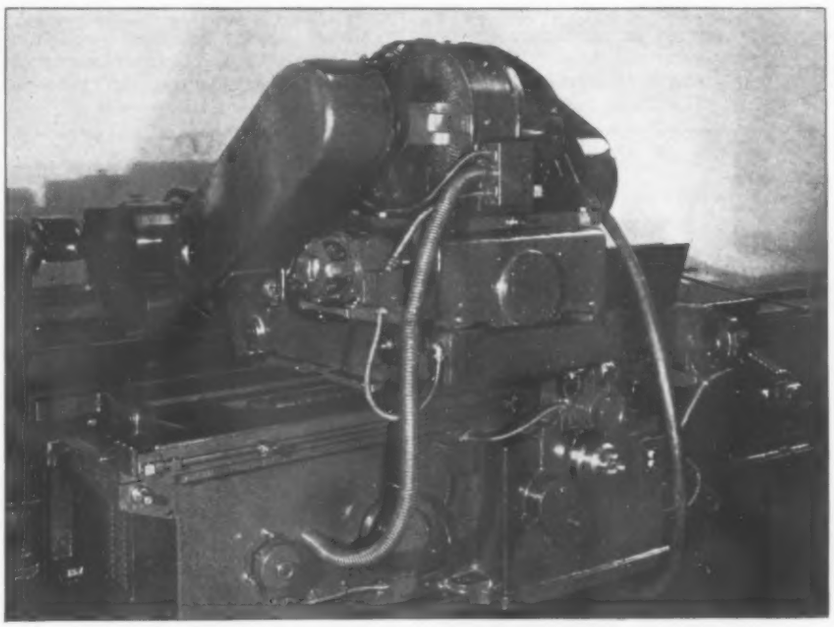
American Society of Tool Engineers. Annual meeting. Detroit, Mich., March 24–29.

Machine and Tool Progress Exhibition. Sponsored by the American Society of Tool Engineers. Convention Hall, Detroit, Mich., March 25–29.

National Metal Trades Association. Annual convention. Palmer House, Chicago, Ill., May 8 and 9.

SHOP EQUIPMENT NEWS

Farrel-Birmingham Taper Grinding Attachment Produces Accurate Tapers in Minimum Time



Built into the Type TT roll grinder at the time of manufacture, this tapering attachment developed by Farrel-Birmingham Co., Ansonia, Conn., incorporates design features which enable the accurate grinding of tapers in minimum time. Among the features of this attachment are included a solid rigid one-piece work table which will accommodate shafts with large diameter flanges, non-backlash construction, mechanism which can be offset in either direction, and simple single adjustment for tapers.

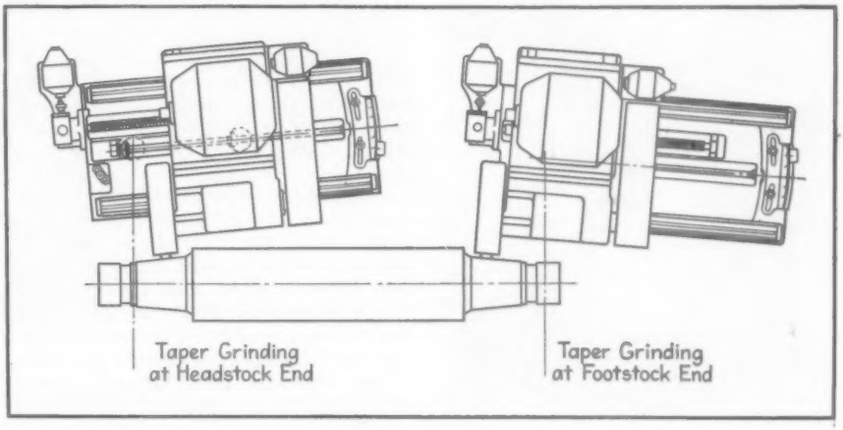
This attachment will grind tapers equally well in either direction. Design and construction eliminate backlash and deflection in machine parts, and hence eliminate a prime cause of poor finish or excessive time in attempting to obtain acceptable accuracy and finish.

Since the mechanism can be offset in either direction, both necks of a roll can be ground without turning the roll around. Thus a roll can be tapered on both necks and finish ground on the body without disturbing the original setting, with positive assurance that the roll will be true. This effects a significant reduction in grinding time.

A simple adjustment gives the exact amount of taper without additional adjustments of the footstock or other units of the machine. The tapering device is controlled from the operator's position in front of the machine and the movement of the grinding wheel is controlled by the wheel feed mechanism, also in front of the machine.

A slight inaccuracy in returning the swivel base to position for straight body grinding will not cause any damage, as the grinding wheel will be dressed parallel to the axis of the roll, the position of which has not been disturbed. Any commercial taper can be accurately reproduced.

Taper grinding is accomplished by mounting the wheelhead and the subbase on a sliding table, which is in turn supported by a swivel base mounted on the back bed. On top of the swivel base are longitudinal V-ways to meet corresponding ways on the under side of the table. The swivel base is pivoted at one end and offset at the other by means of an adjusting screw and nut. When in position for taper grinding the grinding wheel is traversed on its sliding table. This unit traverses and reverses automatically by reversing motor with adjustable dogs and limit switches controlling the travel distance.

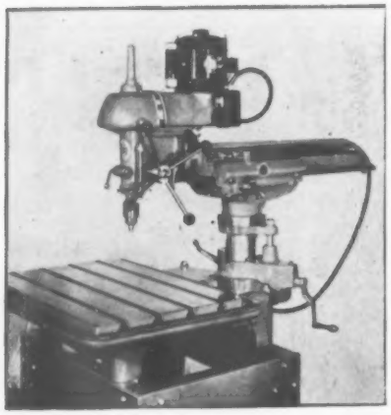


Walker-Turner Radial Drill Suitable for Aircraft Work

Walker-Turner Co., 602 Berckman St., Plainfield, N. J., has developed a small radial drill for performing light duty operations, claimed to be well suited to work of the nature performed in the aircraft industry. This drill is adaptable for such operations as drilling, tapping, routing and light profiling.

The drill head is mounted on a heavy cast-iron ram which rides back and forth in a supporting cradle on eight precision ball bearings. This permits rapid movement, forward or back, and reduces lost motion to a minimum. The ram can be quickly locked in any desired position with a quarter turn of the conveniently located clamp. The drill head, ram and cradle swing easily right and left on a machined collar mounted on the top of the raising and lowering column. A clamp permits locking the drill in position quickly. The drill head ram and cradle are raised and lowered by a crank-operated screw mechanism mounted on the side of the supporting column. A clamp lock is provided here also. The drill head can be tilted 45 deg. either right or left and securely locked in position.

Capacity of the drill is said to be unusually large, drilling to the center



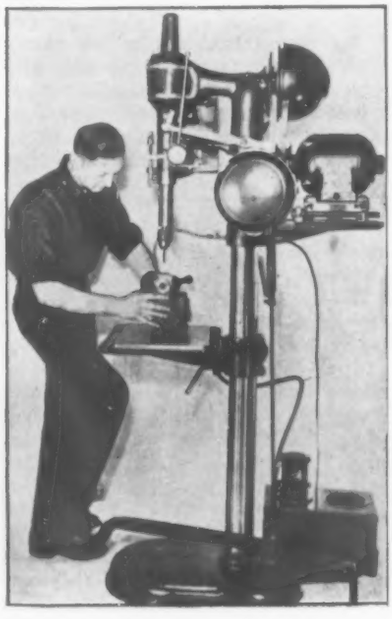
of a 62-in. circle. Ram travel is 18 in. Maximum distance of chuck to table is 13½ in. Vertical movement of drill head is 8½ in. and spindle travel is 3¾ in. Capacity of the Jacobs chuck is ½ in. Height over-all is 72 in.

Cleveland Tapping Machine Adjustable for Hole Depths

Cleveland Tapping Machine Co., 1725 Superior Ave., Cleveland, Ohio, has developed the Model C tapping machine which taps holes of different depths without changing the stop gage. This is done by means of a spacer hinged on the housing which contacts a reversing lever.

Conveniently arranged controls permit easy adjustment. The spindle is mounted on ball bearings and controlled either by hand or foot lever. A 1-hp. motor driving through V-belt gives four spindle speeds from 260 to 820 r.p.m. The machine taps from ¼ to ½ in. in standard steel.

Operator's hands are left free to handle the work since the spindle automatically stops revolving forward and has a split-second reverse. The spindle then raises and starts revolving forward, ready for the next operation.

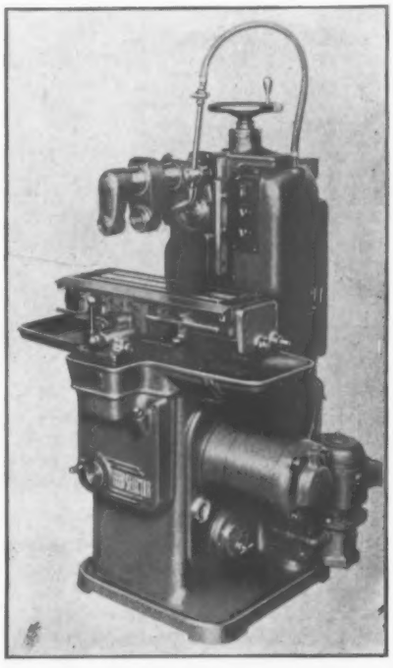


Small Parts Can Be Finished at High Speed With Sundstrand Machine Tool "Rigidmil"

Available with either power feed or hand feed, the No. 00 "Rigidmil" has been developed by Sundstrand Machine Tool Co., Harrison & 11th Sts., Rockford Ill., for high production milling of small parts. Both models are driven by a ¾-hp. spindle motor.

The power feed machine shown has a hydraulically actuated table. Use of hydraulic feed makes possible a wide range of automatically controlled table cycles, including two-way cycles and skip feed. Climb or conventional milling can be done either separately or in combination.

The table has a maximum stroke of



8 in. and a rapid traverse rate of 400 in. per min. Feed and rapid traverse strokes can be regulated to suit requirements. Two feed ranges are available, one from ½ to 37 in. per min., and the other from 1¼ to 66 in. per min. Any feed rate within the range of the machine can be secured by adjustment of a feed selector dial.

An outstanding feature of the machine is the wide range of spindle speeds possible with the high ratio head. The ratio between the high and low speeds is 42½:1, which makes possible the machining of practically all materials without sacrifice in production or finish because of lack of speed range.

Two heads are available with speeds from 57 to 2,415 r.p.m. and from 85 to 3,600 r.p.m. The head is so designed that one set of pick-off gears provides four speed changes, and the four sets of standard gears furnished with each machine supply sixteen speed changes. The head is of the independently motor driven type so that the full rated horsepower of the machine is delivered at the spindle nose, less slight frictional losses. A separate motor drives the hydraulic unit. Machine is of unit type construction and is provided with automatic lubrication to all moving parts.

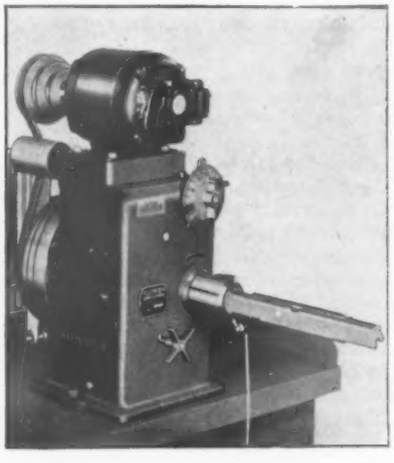
The hand feed machine is made up of the same basic units as the hydraulic feed machine, and can be easily converted to power feed. Table movements are controlld by a long hand lever. The length of stroke with a 90-deg. movement of the lever is 3 $\frac{3}{16}$ in. which can be adjusted through a 10-in. range. For long movements of the table, a handwheel can be furnished in place of the lever.

The head can also be fed vertically, the maximum length of stroke being 2 in. This feed stroke can be adjusted within an 8⅜ in. range. An adjustable counterbalance offsets the weight of the head so that vertical movements are easily controlled. Head travel can be accurately limited by a positive stop which has a micrometer adjusting dial. The head can also be accurately clamped in relation to the machine table when vertical movement is not required. This machine has the same 42½:1 ratio head as furnished on the power feed machine.

Sunnen Precision Honing Machine Finishes Internal Cylinders

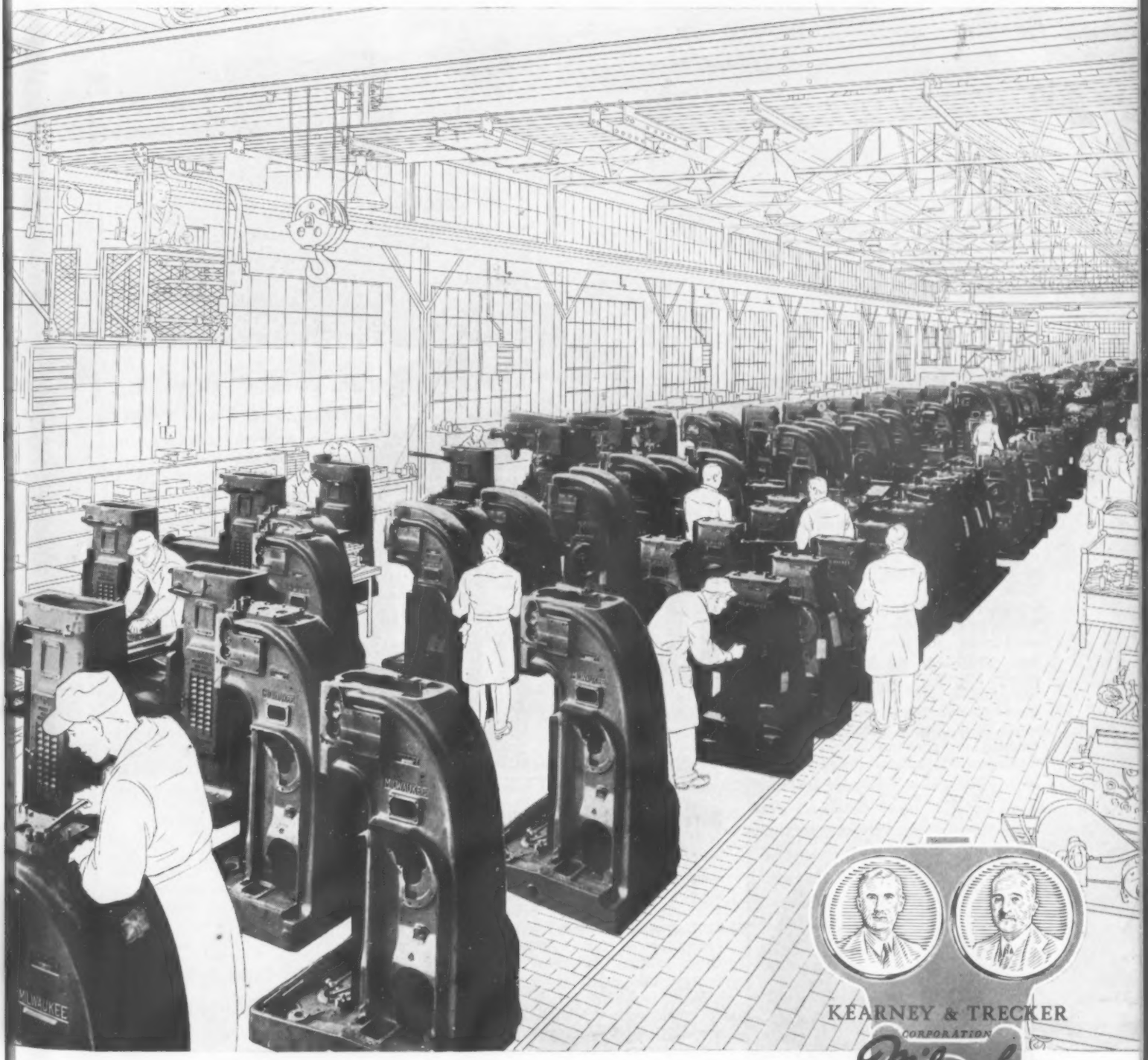
Model MA precision honing machine developed by Sunnen Products Co., 7941 Manchester Ave., St. Louis, Mo., is said to be an accurate, low-investment machine for honing internal cylindrical surfaces. This machine will grind and finish any hole from 0.185 to 2.400 in. in diameter and up to 7 in. long with a guaranteed accuracy of 0.0001 in.

It corrects taper, wave, rainbow and bell-mouth conditions and maintains accurate alignment between two or more parallel bosses. Previously established axial alignments are accurately maintained. The machine is suitable for production, maintenance, salvage and tool and die work.



MASS production of milling machines . . . a partial view of the assembly floor of the largest plant in the world devoted exclusively to the manufacture of milling machines.

KEARNEY & TRECKER CORPORATION • Milwaukee, Wis., U. S. A.

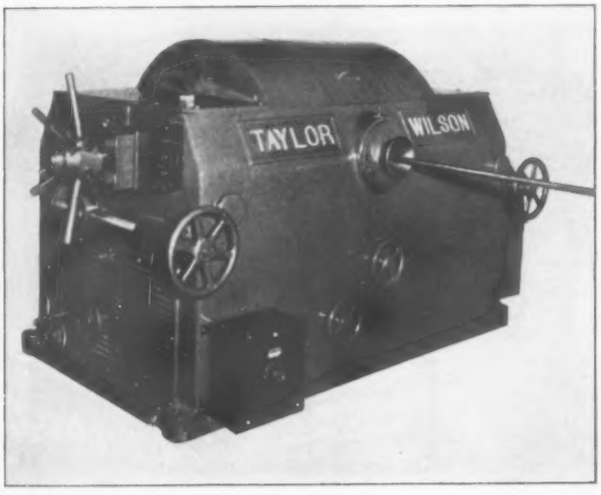


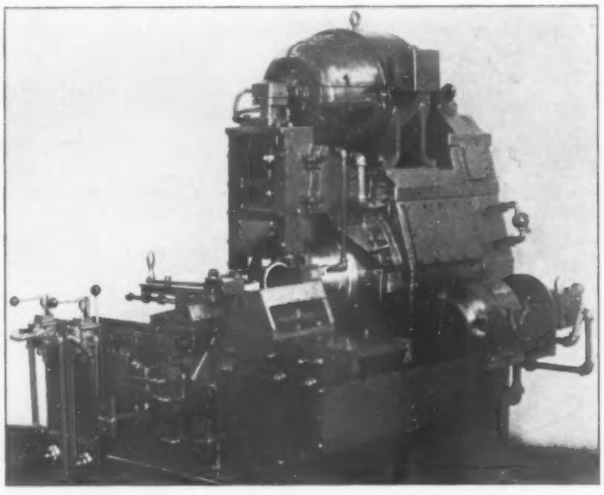
MILWAUKEE MILLING MACHINES

Taylor-Wilson Straightening, Sizing and Burnishing Machine Handles 3-In. Bars

Taylor-Wilson Mfg. Co., McKees Rocks, Pa., has developed a cross roll straightening, sizing and burnishing machine which handles tubular and bar stock from $\frac{1}{16}$ to 3 in. in diameter. Simplified construction promotes compact design and long life.

With a minimum number of controls conveniently located and properly calibrated, all adjustments are positive. As a result, the machine can quickly, easily, and accurately be adjusted for all sizes and types of bar and tubular material within its capacity. This machine processes stock at delivery speeds as high as 300 ft. per min., straightening and sizing to tolerances as close as 0.0002 in. It produces greatly improved finishes on cold drawn stock, or mirror finishes on turned and ground stock. It handles hot-worked bars and tubular materials, in addition to cold-processed bars and tubes. In recent months, manufacturers of thin-walled alloy airplane tubes have adapted this straightener to their work. The device is also used for reeling this tubing off mandrel rods.

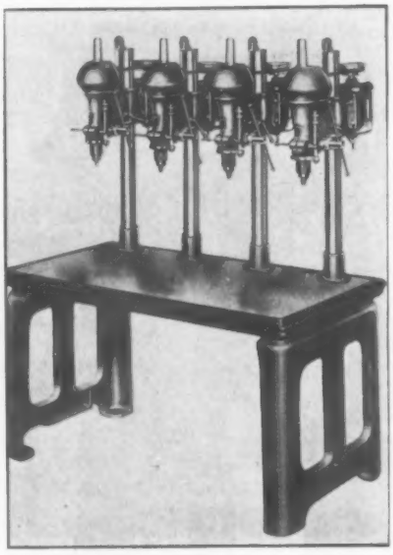




"Modern" Inserted-Blade Cutter Features Positive Locking

Design of Types B and C inserted blade milling cutters, offered by Modern Tool Works, Rochester, N. Y., is said to be such that the blades will not slip under the heaviest cut and that resetting and sharpening are quick and positive. Stop pins in the cutter body, over which the notched blades rest, form a positive lock and prevent the blade from changing position.

Cutter body is made from a hammered forging, normalized after rough machining, finished, then hardened and ground on all bearing surfaces. Blades are easily adjustable simply by loosening a nut. They are made in styles to use either Stellite or high-speed steel blades. They are recommended for medium rough and fine finishing cuts on cast iron, malleable iron, brass, etc., where the depth of cut does not exceed $\frac{1}{16}$ in.



Duro Multiple-Spindle Drill Performs Lighter Type of Work

Duro Metal Products Co., 2649 N. Kildare Ave., Chicago, Ill., has developed a multiple-spindle drill press for light drilling and tapping. Available with either two or four spindles, this machine utilizes spindles running on permanently lubricated ball bearings.

Splined shafts permit long chuck travel. Jacobs chucks take up to $\frac{5}{8}$-in. drills. Hinged motor mounting simplifies changing of belt speeds. A 2¾-in. diameter steel column reduces vibration. Four-spindle table measures 20½ x 50 in. Distance between spindles is 12 in.; from chuck to table, 26 in.

Hydraulic Cutting-Off Machine Takes 20-In. Diameter Stock

Taylor-Wilson Mfg. Co., McKees Rocks, Pa., manufactures this hydraulic cutting-off machine in a series of sizes to handle solid and tubular stock in diameters from ¾ to 20 in. In operation, this machine accurately cuts to any desired length, chamfers the edges and removes burrs.

Construction, although rugged, is nevertheless compact. Hydraulic controls, conveniently and centrally located, are used throughout. Timken bearings are standard equipment. The cut-off tools, hydraulically operated, have a rapid approach, controllable cutting feed, and quick return. Chucking is done with collets operated by a hydraulic cylinder. Only the touch of a finger is necessary to obtain any of a number of spindle speeds or tool feeds. The machine is quickly and easily adjusted to handle any size of stock within its capacity.

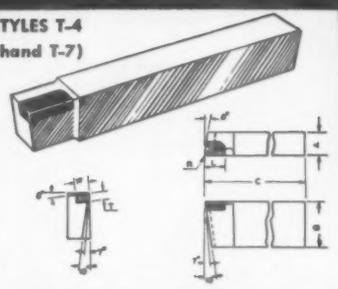
The machine is suitable for crop ending pipe and cutting-off set lengths of pipe, such as boiler tubing and coupling blanks. It also can be used for cutting-off shell blanks from seamless tubing.

Thread-Cutting Lathe Added To Hannifin Toolroom Machine

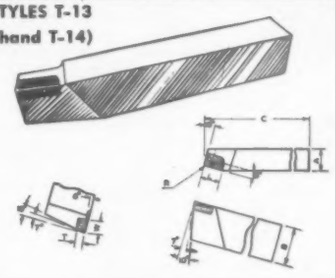
The No. 10 toolroom machine recently introduced by Hannifin Mfg. Co., 621–631 S. Kolmar Ave., Chicago, Ill., (AM—Vol. 84, p. 437) has been improved by the addition of a thread-cutting lathe. Other devices built into

FOR FASTER DELIVERY and MAXIMUM ECONOMY *Specify* THESE STANDARD CARBOLOY TOOLS!

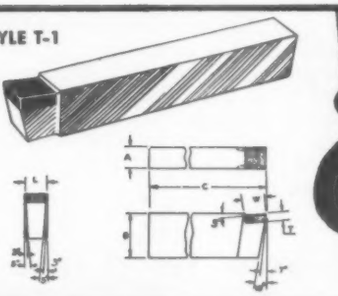
STYLES T-4
(left hand T-7)

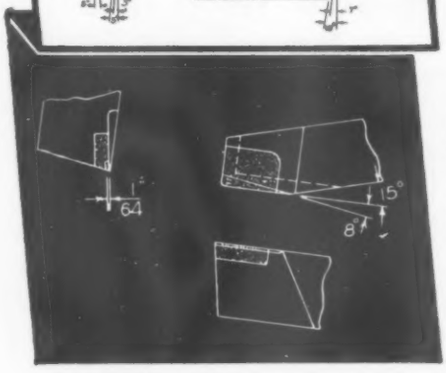


STYLES T-13
(left hand T-14)



STYLE T-1





ALL STANDARD TOOLS ARE GROUND READY FOR USE

Steel Cutting Tools Styles 4, 7, 13, 14 have ground-in chip breaker as illustrated above.

SPECIFICATIONS—CARBOLOY STANDARD TOOLS

TOOL ORDER NUMBER					Shank Size		
Right Hand Style T-4	Left Hand Style T-7	Right Hand Style T-13	Left Hand Style T-14	Style T-1	A	B	C
T-42 T-43	T-72 T-73			T-12 T-13	5/16 3/8	5/16 3/8	2 1/4 2 1/2
T-45 T-47	T-75 T-77	T-137	T-147	T-15 T-17	1/2 5/8	1/2 5/8	3 1/2 4
T-48 T-406	T-78 T-706	T-148 T-1306	T-148 T-1406	T-18 T-106	3/4 1	3/4 1	4 1/2 6
T-140 T-403	T-710 T-703	T-1310	T-1410	T-110 T-103	1 1/4 5/8	1 1/4 1 1/4	6 7
T-404	T-704	T-1304	T-1404	T-104	3/4	1 1/2	7

Vest pocket size 16-page instruction manual packed with each tool.

Standard grades supplied with these tools: Grade 78B for steel cutting. For cast iron, brass, etc., grade 44A and (for longer tool life on rigid set-ups) grade 883.

FOR "UNIVERSAL" SHOP USE ON 80% OF ALL STEEL, CAST IRON, ETC., TURNING, BORING, FACING JOBS

For fast delivery, maximum economy, easy ordering and simplified stocks, specify the new, recently announced Carboloy Standard Tools.

Just five styles—in three grades—are designed for universal use on 80% of all turning, boring and facing jobs on steel, cast iron, brass, etc. Rapid grinding procedure permits grinding innumerable variations in each tool. Proper carbide grade selection—often a problem—is practically automatic with these new standards. One grade for steel cutting; two for cast iron, brass, etc.

Take advantage of the new economies and broader uses now possible with Carboloy Tools through these simplified design and grade selection features and the new low prices (approaching the price of ordinary tools). Write for Catalog GT-125.

CARBOLOY COMPANY, INC., 11149 E. 8 MILE ST., DETROIT, MICH.

Chicago • Cleveland • Los Angeles • Newark • Philadelphia • Pittsburgh • Worcester, Mass.

The Mark of CARBOLOY REG. U.S. PAT. OFF.

Look for this triangular trade mark on tools you buy. It is your assurance of genuine Carboloy cemented carbide.

CARBOLOY

REG U S PAT OFF

TUNGSTEN CARBIDE—TANTALUM CARBIDE—TITANIUM CARBIDE

FOR CUTTING, DRAWING, SHAPING, EXTRUDING METALS AND NON-METALLICS • FOR REDUCING WEAR ON EQUIPMENT OR PRODUCTS YOU USE OR MAKE

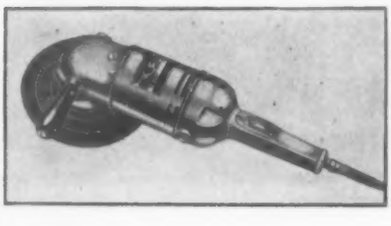
the machine include a sensitive drill press, horizontal milling machine and vertical milling machine.

The semi-steel lathe bed is of special rectangular section, mounted on a heavy base, providing utmost strength and rigidity. Compound slide has power longitudinal feed, with a quick-change gear box giving 45 thread pitches from 4 to 120, and 63 feed changes from 0.250 to 0.0021 in. Compound slide has rapid adjustment clamping features and ground adjustable take-up gibs. Tool-post rest is graduated, allowing accurate settings 60 deg. either side of center.

The lathe is driven by a reversible 1-hp., 1,725 r.p.m. motor, giving twelve spindle speeds from 85 to 1,250 r.p.m. Spindle is mounted in preloaded ball bearings. The lathe swings 9 in. over the bed and measures 18 in. between centers.

Stanley Heavy-Duty Sanders Designed for Longer Life

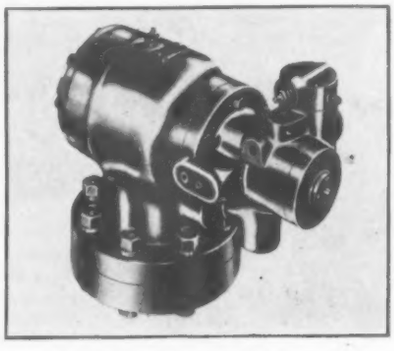
A pair of heavy-duty sanders offered by Stanley Electric Tool Div., Stanley Works, New Britain, Conn., includes many mechanical refinements to make for long life and trouble-free service. These refinements include aluminum alloy housings, dust- and dirt-free seal type ball bearings on armature and spindle, heavy-duty nickel steel precision spiral gears, totally inclosed double pole switch, powerful ventilated universal motor, etc. Sander No. 72 takes a 7-in. diameter disk and has a speed of 4,200 r.p.m. It weights 17¼ lb. No. 92 takes a 9-in. diameter disk at a speed of 3,300 r.p.m. It weighs 18 lb.



Vickers Hydraulic Press Control Automatically Eliminates Shock

Elimination of shock in operation of hydraulic presses is featured in the design of a pressure-actuated prefill surge valve developed by Vickers, Inc., 1400 Oakman Blvd., Detroit, Mich. This valve is automatic in operation, incorporating a control feature insuring that the pressure in the main ram must be reduced to a nominal percentage of the maximum operating pressure of the system before the valve can open. This feature serves to minimize shock at reversal due to the compressibility of the oil and the elasticity of the press members.

The valve also incorporates as an integral part of its assembly the necessary sequence valves so that the piping is reduced to a minimum. A visual indicator is also provided which enables the operator to determine at a glance the position of the main valve. This feature facilitates setting up and testing the hydraulic equipment in the press circuit. The sequence valves are

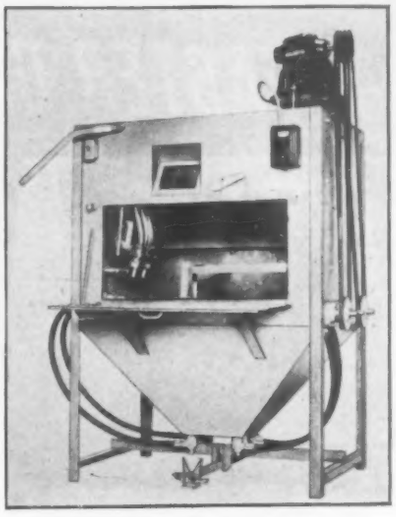


readily adjustable for various operating pressures, and may be remotely controlled when desirable to provide slow or rapid operation of the press for setting up and checking dies. These valves are available in 4, 6 and 8 in. nominal pipe sizes. They are designed for operating pressures up to 3,000 lb. per sq. in. and can be supplied either with or without connecting flanges.

Leiman Automatic Sandblast Cleans Cylinders and Shell

Many types of metal cylinders and shell can be cleaned automatically with the cabinet type sandblast machine offered by Leiman Bros., Inc., 101EE4 Christie St., Newark, N. J. This four-nozzle machine for cleaning and finishing the inside and outside of tubing and solid pieces of work is equipped with two rotating fixtures for holding and turning the parts. Vertical nozzles travel longitudinally to clean the outside surface of the revolving pieces on the fixture, while side nozzles are used for cleaning the inside of any article which may be hollow.

The machine is self-contained, the sand placed in the lower tapered section being automatically fed to the nozzles



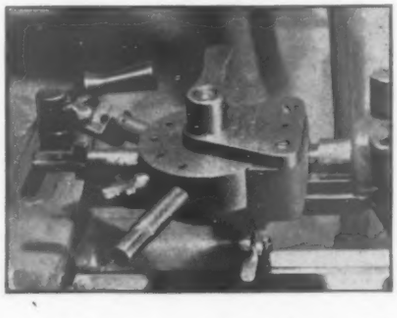
by air pressure when it drops to the bottom of the machine. It is used over and over again. The machine is heavily constructed of sheet steel and all parts are welded. It is equipped with a foot control lever. The lever at the top of the cabinet is used for raising and lowering the nozzles.

Rotating fixtures are motor driven, but they may be arranged for hand manipulation if so desired. In operation the front door is closed, when the progress of the work may be readily observed through a glass window directly over this door. Specifications: size of cabinet, 36 x 48 in.; height of cabinet, 68 in.

"Quadruplex" Tailstock Turret Increases Lathe Versatility

Productivity of any bench or floor type engine lathe is increased fourfold with the "Quadruplex" tailstock turret offered by Specialties Mfg. Co., 35 Farrand St., Bloomfield, N. J. This device has four positions for tools having ⅝ in. diameter shanks, and comes finished with a No. 2 Morse taper shank for instant installation in the lathe tailstock. The device can also be installed on one face of the turret lathe, thereby allowing three more operations to be accomplished in the same set-up.

The turret is operated by releasing a clamp handle, pressing down on an index handle and turning the tool into position for use. The clamp handle is then retightened for rigidity. Special shanks are also available.



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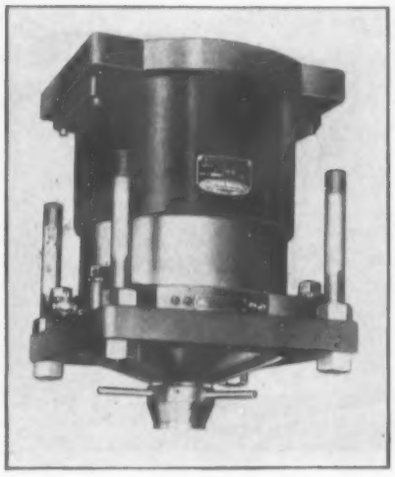
B&S Cutter Grinding Device Manufactured in Two Types

Both through-feed and in-feed types of the No. 10 cutter sharpening attachment are offered by Brown & Sharpe Mfg. Co., Providence, R. I. The through-feed type, shown at the left, gives a straight cut across the entire tooth face and provides for efficient and accurate sharpening of formed cutters up to 6 in. in diameter with straight teeth. With the in-feed type, right, formed cutters from 2 to 6½ in. in diameter with straight teeth may be sharpened.

The through-feed type uses a dish wheel with the wheel spindle at right angles to the table. The cutter is supported on a horizontal arbor between the centers of the machine and is passed across the face of the wheel by traversing the table. This attachment consists of a rigid, adjustable tooth rest assembly mounted at the top of a sturdy column which is adjustable vertically to accommodate cutters up to 6 in. A rack and pinion provide easy, positive adjustment and the rack serves as a key to maintain angular alignment. The supporting bracket which carries the column is adjustable transversely along dovetail ways in a solid base; and this base in turn is tongued for accurate alignment and is bolted to the machine table.

The in-feed type of attachment uses a dish wheel with the wheel spindle set at right angles to the table, while the cutter is supported on its side in a horizontal plane and advanced into the edge of the wheel by feeding the table. This attachment is recommended for cutters not more than 1½ in. wide. It consists of an adjustable tooth rest assembly and a body for supporting the cutter, mounted on a base plate which is tongued for alignment and bolted to the top of the tool rest. The upper part turns on a pivot extending through the base plate, and the cutter is placed on a vertical stud which is inserted in a hole concentric with the pivot. The tooth rest assembly is carried by a bracket at the left end of the attachment body, the tooth rest itself being adjustable vertically as well as for cutter diameter.

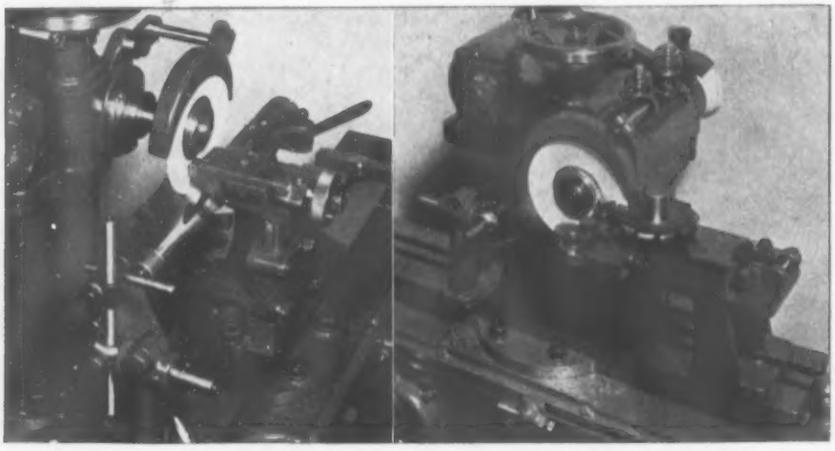


Pneumatic Die Cushion Is Completely Self-Contained

Dayton Rogers Mfg. Co., 2830 S. 13th Ave., Minneapolis, Minn., has brought out Model DM universal pneumatic die cushion, which is completely self-contained, requiring no surge reservoir, and furnished with a combination regulator and gage for shop air line connections.

These cushions can be adapted to all punch press deep drawing operations, and can be used for pressure pad control on a large percentage of forming dies. All pin pressure pads are fabricated for the individual press application, with the correct amount of press bed clearance in each case. The correct height of the pin pressure pad is maintained and controlled by the handwheel adjustable feature, making it unnecessary to correct the length of the pressure pins, compensating for bolster plate thickness variations, for sharpening and grinding of compound dies, and for any other changes in die design.

This type of cushion installation makes it possible to remove the bolster plate at any time, without disturbing the cushion. The device is available in six sizes, having deep drawing capacities of 5 in. and less, with ring holding pressure up to 10 tons on a 100-lb. air line.



Hydraulic Machine Control Makes Possible Complex Cycles

Remote automatic machine cycle control is featured in the traverse and feed control panel offered by Vickers, Inc., 1400 Oakman Blvd., Detroit, Mich. This unit is entirely solenoid controlled and designed for cycles incorporating rapid advance, feed, rapid return and stop.

The panel unit may be mounted at any convenient location on the machine and controlled remotely through electrical contacts actuated by the motion of some machine element. The unit incorporates means for manual control for set-up purposes, eliminating the necessity for auxiliary jogging buttons. Length of the working stroke is adjustable by positioning the contact operating dogs. A large variety of traverse and feed cycles can be obtained with this unit by various combinations of contact-actuating dogs in the desired sequence. The panel can be supplied with or without the mounting subplates. Failure of the electrical power automatically stops the cycle.

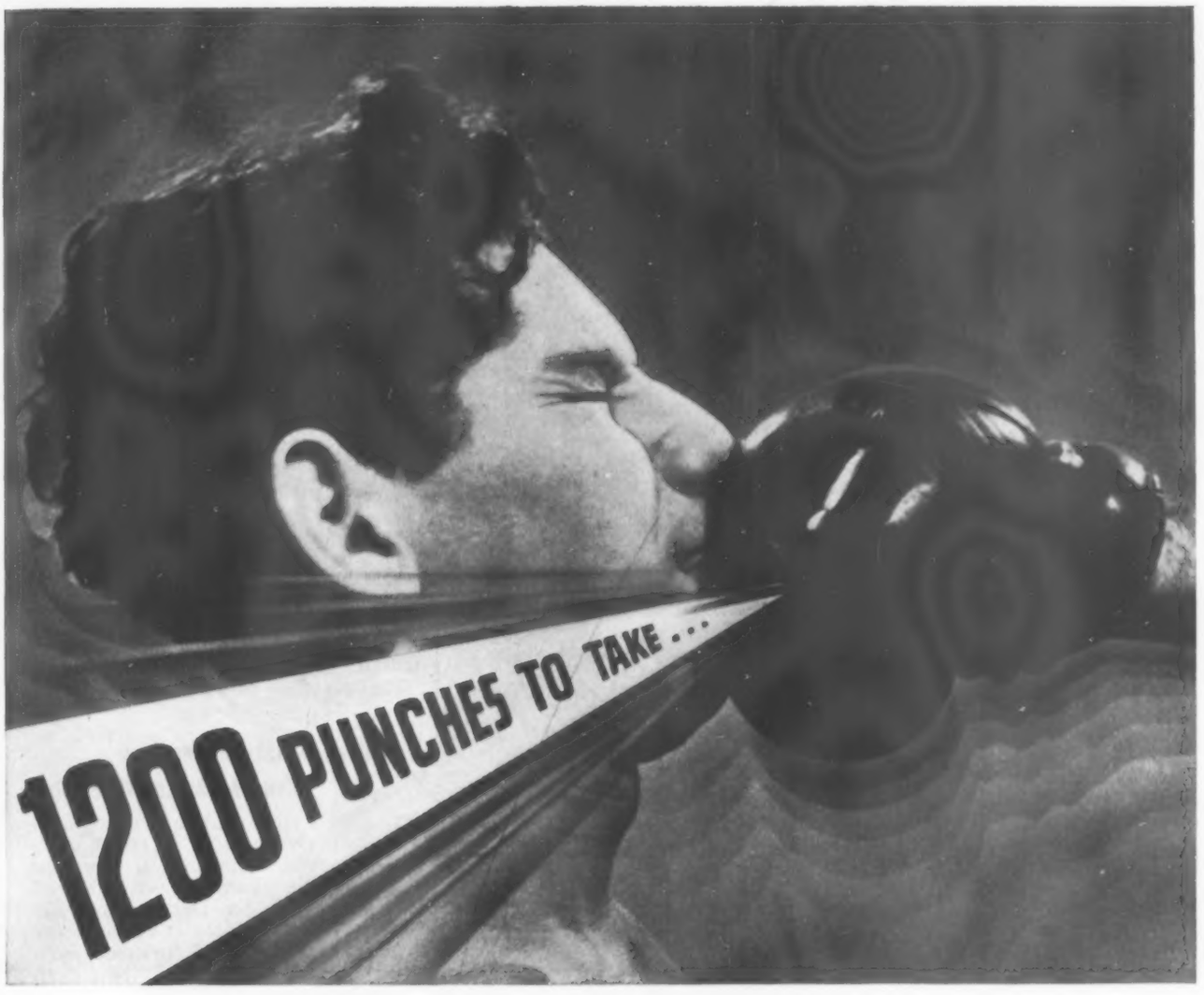
Taber "Abraser" Machine Tests Abrasion Resistance

Taber Instrument Co., North Tonawanda, N. Y., has developed the Research Model "Abraser" machine for accurate evaluation of resistance of surface finishes to abrasion. Finishes such as paints, lacquers, plating and plastic surfaces can be tested with this device.

The primary elements are a motor-driven turntable on which the specimen is mounted, a counter to indicate the number of cycles, and two abrading wheels which alternately rub back and forth, and at the same time criss-cross in their rolling path. These wheels are made in five types of closely controlled resilient material charged with special grades of fine abrasive grain.

The Research Model is provided with standardized load adjustment for varying the pressure of the wheels against the specimen to suit the type of material being tested. Wheel pressure accelerates the test to the point where the duration of the result ranges from 500 to 5,000 abrasion cycles.

Supplementing the wear resistance



AN alloy was needed for a spinnerette for artificial fibre. The thickness of the spinnerette was limited to .008 inch. And 1200 holes had to be individually punched into its small area.

In addition, the alloy had to have high corrosion resistance and strength.

Revere was able to deliver a special alloy that could take all 1200 punches and still give the needed strength and corrosion resistance.

In modern metal working, many seemingly impossible tasks are possible *provided* you can get the right metal *to work.* Often minute, controlled amounts of special ingredients are able to give the familiar coppers, brasses, bronzes and other alloys exceptional qualities. In recent years, Revere Copper and Brass Incorporated has studied the effects of these minute, minor ingredients. Its laboratory findings have, in many instances, been confirmed by excellent operating records in industry.

These findings of Revere may be helpful to you. And the Revere Technical Advisory Service is available for special and individual cooperation with you on problems to which copper or copper-base alloys may be the answer.

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test is the shear-hardness test performed by attachment E-3720 which measures the toughness quality of a plastic surface or its ability to resist digs, scrapes, and similar physical damage not classed as normal wear.

Cunningham Roll Brander
Cuts Required Marking Time

It is claimed that the time of marking mill rolls can be reduced from about 8 hr. to 30 min. with the floating type roll brander offered by M. E. Cunningham Co., 160 East Carson St., Pittsburgh, Pa. Both roll and roll holder are of one-piece construction to eliminate any possibility of thread or screw failures.

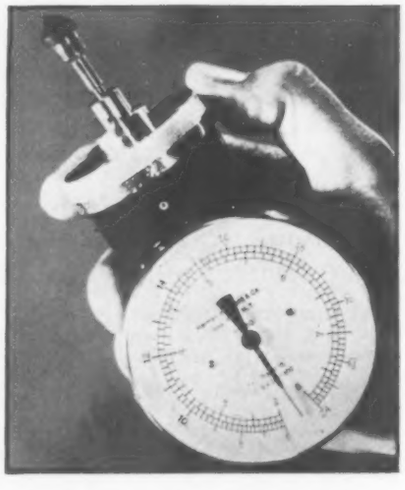
The unique floating type feature allows each piece of type to level itself in the roll with no chance of being wedged in an off position. This results in a much clearer branding with every character the same depth. This same floating type feature eliminates type breakage because the pressure is always on the center line.

The type is engraved with a background clearance which eliminates chipping of the edges of characters when the branded roll is put in operation. No bearings are needed because of special shaft design. The steel type is inserted and held in place by a method which eliminates the need for spacers and reduces set-up time.

Scherr "Magni-Ray"
Lights Work for Inspection

George Scherr Co., 148 Lafayette St., New York, N. Y., has developed the "Magni-Ray" wide-field illuminated magnifier for use in inspection of small parts. This magnifier comes with a stand which may be removed so that actual machining operations can be watched while the work is in progress.

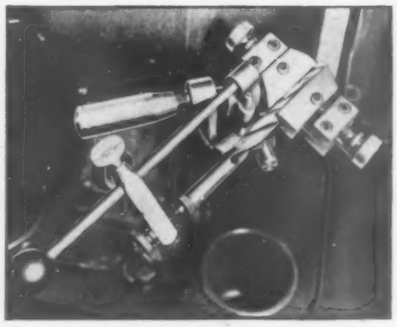
Two models are available, one with a highly specialized achromatic lens providing a 2-in. field at a magnification power of 3 X. The other has a 3-in. lens with a power of 1½ X.



"Standco" Hand Tachometer
Handles Extreme Ranges

Speeds from 30 to 48,000 r.p.m. can be accurately determined with the "Standco" universal hand tachometer offered by Herman H. Sticht Co., 27 Park Place, New York, N. Y. This direct reading centrifugal type instrument has a rotating gear shift in a knurled cover for changing to the five speed ranges.

A 3-in. diameter dial, easy to read scales, and knife-edge pointer promote utmost precision. Accuracy is guaranteed to be within ½ of 1 per cent.



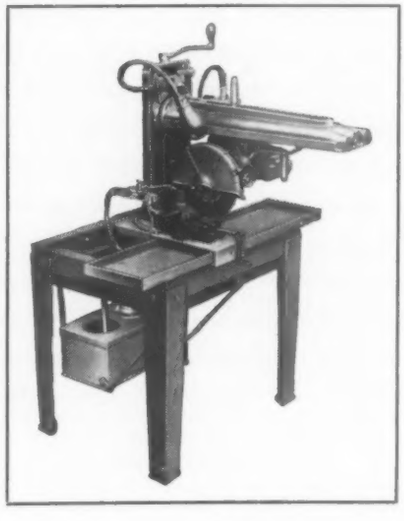
Drill Grinding Attachment
Sharpens Drills Accurately

Offered by Delta Mfg. Co., 620 E. Vienna Ave., Milwaukee, Wis., this drill grinding attachment which uses the face of the wheel is a precision unit easy and simple to operate. A setting attachment with an accurate scale permits micrometer settings that insure evenly ground lips so that drills run true. An additional feature permits drills to be ground to fit the job with lip clearance and angles at any degree required. The device has a capacity of ⅛- to ⅝-in. drills.

Wallace Metal-Cutting Saw
Uses Abrasive Wheel Also

The No. 1 metal-cutting saw developed by J. D. Wallace & Co., 134 S. California Ave., Chicago, Ill., employs either $\frac{3}{32}$-in. abrasive wheels or special metal-cutting saw blades. The machine is thus capable of cutting steel, iron, brass, aluminum, duralumin, copper, high-speed steel and nearly all kinds of alloys.

Wheels and blades have a maximum cutting depth of 4 in. and will handle work within the capacity of the 1- and 2-hp. motors. Coolant pump, vise-carrier, and rapid-acting vise are available for general use in cutting bar stock, tubing and metal moldings. In addition to straight cut-off work, this machine is quickly set up for angle cuts.



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Precision, smooth finish, uniformity are the prime qualities you insist on in cold drawn steel bars. Our first responsibility to all our customers is to maintain these qualities.

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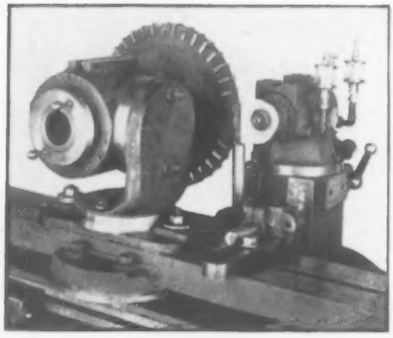


Covel Grinding Attachment Handles Larger Face Mills

Covel Mfg. Co., Benton Harbor, Mich., has developed a face mill grinding attachment which handles larger cutters than previous models. It can be used for all types of grinding on a universal cutter and tool grinder and especially adaptable for grinding milling cutters and taper reamers.

The spindle swivels in both directions 360 deg. and can be securely locked. Spindle is mounted in adjustable precision ball bearings to eliminate end and side play. The device can be mounted on any grinder having a flat top table from 4½ to 6 in. wide.

The device has a No. 7 Morse taper hole in the spindle. Distance from the base to the center of the spindle is 6¾ in. Size of the base is 5¼ x 7½ in.

Drill Press Attachment Provides Wide Speed Range

An attachment developed by Delta Mfg. Co., 620 E. Vienna Ave., Milwaukee, Wis., for 14-in. drill presses provides a wide range of speeds for both high-speed and low-speed models. This attachment consists of a heavy casting which mounts in the drill press column together with a cone pulley and two belts. Belt slack is taken up turning the casting so proper tension is always assured. A range of twelve speeds is available through various combinations.

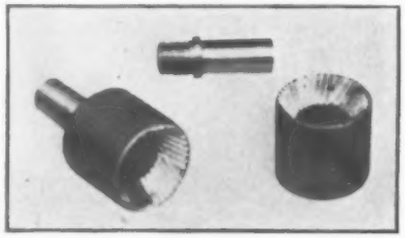
The multi-speed unit is quickly removed and easily adjusted. A grease-sealed ball bearing pulley is used in the assembly to insure smooth running.

Small Boring Bar Set Made Available by Flynn Mfg.

Small boring bars for the toolmaker, diemaker, and all-round machinist comprise set No. 62 offered by Flynn Mfg. Co., 433 Bates St., Detroit, Mich. Made for all types of small boring, these bars are made of hard steel with high-speed steel toolbits.

Three of the bars are double-end with 45- and 90-deg. toolbits. Only the smallest is single end, of 45 deg. Tool-

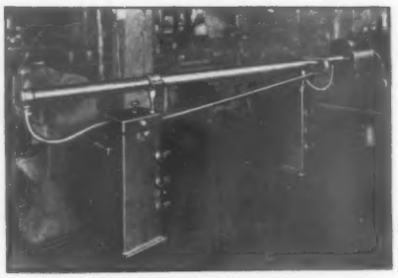
bits are held in place by Allen setscrews and are easily replaced. All toolbits are of high-speed steel with a flat ground on one side for locking. Sizes of bars are ¼, $\frac{5}{16}$, ⅜, and ½ in. Corresponding toolbit sizes respectively, are $\frac{3}{32}$, $\frac{5}{16}$, and $\frac{3}{8}$ in. round and $\frac{3}{16}$ in. square. The bars are packed in a leatherette case with five extra round bits and three Allen wrenches.



Severance Deburring Cutter Cleans Rods and Tubing

A cutting tool for deburring ends of rods and tubing has been made available by Severance Tool Mfg. Co., 1520 E. Genesee Ave., Saginaw, Mich. This tool removes rough edges and burrs by producing a slight chamfer. It is also suitable for the removal of flash or similar conditions from edges of bosses, collars, bushings, etc., of cast, forged or molded parts.

Standard mouth angles are 30 and 45 deg. Each cutter size covers rod diameters within a limited range. Special tool design prevents the cutter from loading.



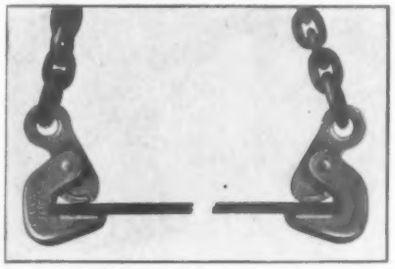
Lipe Pneumatic Bar Feed Simplifies Stock Feeding

This pneumatic bar feed unit developed by W. C. Lipe, Inc., 208 S. Geddes St., Syracuse, N. Y., is a self-contained automatic power stock feed device for use in connection with machine tools having fixed stops for determining length of work. It eliminates feed fingers, collars, chucks, ratchets, rollers, wobble-plates and similar parts of screw machines, turret lathes, cut-off machines, etc. It feeds without surface contact and is claimed not to scratch or mar any material.

This stop will feed any distance and hold the stock firmly against the stop until the collet is closed. Without any set-up change, it will handle all sizes and shapes within the capacity of the machine tool with which it is used. It is said that the objectionable noise caused by whipping of stock in guard pipes is completely eliminated. With it stock is completely inclosed, leaving no whipping end to catch in clothing. Feed power cannot be applied unless cylinder is locked in proper working position. The device is available in three models: No. 125, having a capacity of 1 in. diameter and 12 ft. long; No. 225 with a capacity of 2 in. diameter and 12 ft. long; and No. 300 with a capacity of 2½ in. diameter and 12 ft. long.

"Never-Slip" Safety Clamp Has Replaceable Jaw Insert

An improved type of safety lifting clamp, equipped with a replaceable, grooved, hardened steel jaw liner, has been developed by Never-Slip Safety Clamp Co., P. O. Box 448, Grand Central Annex, New York, N. Y. These clamps, made for either horizontal or vertical lifting of steel plates, sheets or sections, are available in ten styles for handling material weighing up to 10 tons and from ⅛ to 6 in. in thickness.



Anti-Friction Bearing Greases Offered by Gulf Oil Corp.

Two new types of lubricating greases for ball and roller bearings have been developed by Gulf Oil Corp., Gulf Building, Pittsburgh, Pa. One, designated Gulf Anti-Friction Grease, is recommended for heavy-duty service. The other, Gulf Precision Grease, is recommended for lighter duty and higher speeds. Both have high melting points and are specially prepared for great resistance to oxidation and separation.

A newly developed method of compounding, employing special high-pressure kettles and mixing methods, produces these greases with a relatively smooth, non-fibrous texture. Both lubricants are available in a wide range of consistencies for any method of application or operation condition—consistencies recently recommended by the National Lubricating Grease Institute which went into effect March 1.

Manheim "Octopus" Belting Combines Grip and Resilience

"Octopus" flat transmission belting, developed by Manheim Mfg. & Belting Co., Manheim, Pa., is claimed to combine great pulley grip with exceptional resilience. This belting is claimed to effect a material reduction in maintenance and replacement costs.

A method of combining 34-in. duck with a specially impregnated material is said to result in superior characteristics. This belting, however, is not recommended for oily drives. It requires no belt dressing. It is made in widths from $\frac{1}{16}$ in. with from two to twelve plies. It can be fastened by all types of belt fasteners.

Nylon Industrial Brushes Useful in Metal Enameling

Nylon has been successfully adapted for a series of brushes which relieve the American porcelain enamel industry from dependence upon Tampico fiber and uncertain imports of Oriental hog bristle, it is announced by the Plastics Dept., E. I. duPont de Nemours & Co., Wilmington, Del. This industry, which has been using 750,000 old type brushes a year in upwards of 200 plants, has found that Nylon bristles outlast previous materials from three to five times.

Edging brushes bristled with Nylon were first developed. These are used to brush out margins of the top coat of the fluid enamel before the final baking operation. They are made by stapling one to eight rows of bristle to a wooden back. Nylon brushes were then utilized in rotary brushes attached to the ends of power driven shafts. In addition, Nylon stencil brushes for decorating or lettering plates now have been introduced. Exceptional resistance of Nylon bristles to abrasion is of special value in all brushes designed for the porcelain enamel industry.

(advertisement)

Manufacturers Look to Steel Warehouses for Quick Defense Requirements

Many leading manufacturers are relying on nearby steel-service plants for prompt, stock shipment of steel to meet the current surge of business prompted by Washington's defense program.

Probably the leading exponent of "Immediate Steel" is Ryerson with a net work of ten strategically-located plants each of which has large and complete stocks of steel and allied products. In addition, each plant is equipped with complete forming and cutting facilities so steel can be prepared to customers' exact requirements. No shop should be without the Ryerson Stock List (see advertisement below).

Thousands of manufacturers report saving considerable time, trouble and money by taking advantage of Ryerson's complete flame cutting service. Modern equipment manned by specially trained operators can quickly burn any shape—no matter how intricate—from carbon or alloy steel plates and billets up to 15" thick.

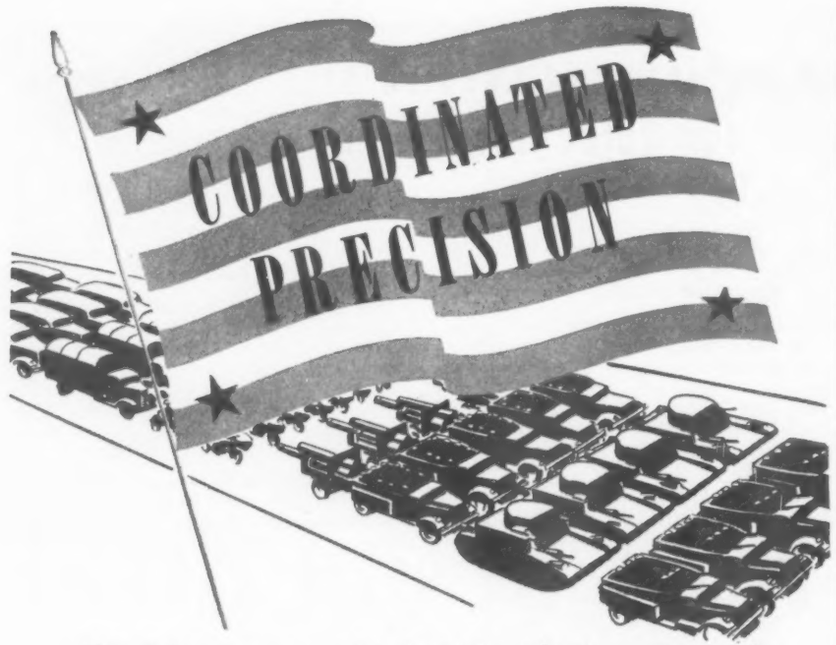
How to get Steel *More Quickly*

A practical suggestion that may help you

SPEED your steel by sending open orders (not inquiries) to a dependable source of supply. We are glad to receive all inquiries and give them prompt personal attention but with today's emergency demands there is a chance that certain stocks may become depleted while the request for quotation is being handled.

Here at Ryerson, stocks are remarkably complete, deliveries are prompt. Out-of-the-ordinary demands may, however, temporarily deplete our stock of a particular size. Because of recent experiences our advice is this: If you need steel, order it! Don't wait for quotations. An open order to Ryerson will get you the same price, and, will be shipped at once.

Have no hesitancy in placing an open order, for Ryerson stands on its 99 year reputation as a reliable, one-price house. You will save valuable time, and more important, you will have the steel you need when you need it. Joseph T. Ryerson & Son, Inc. Steel-Service Plants at: Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City.



The defense program of industrial production again emphasizes the critical need for a thoroughly reliable means of checking the lead of screw threads and rack teeth.

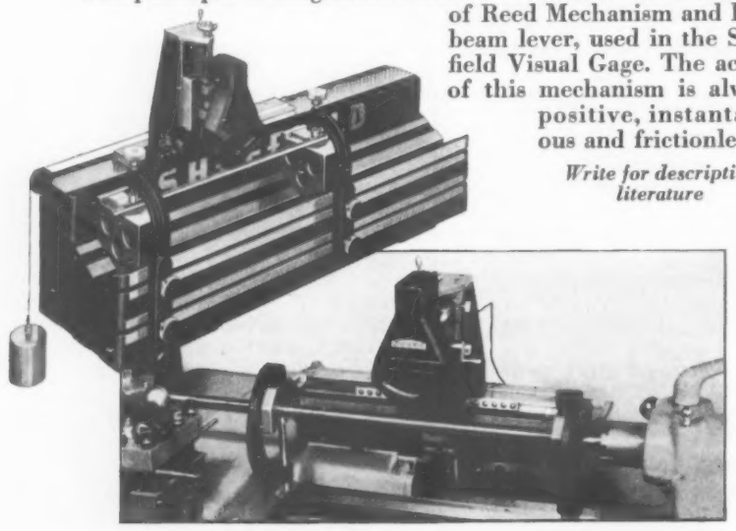
The Sheffield Thread Lead Checking Instrument is the ultimate in accuracy and speed—checking with precision gage blocks as the reference. And no special skill is needed, for anyone familiar with inspection procedure can handle this instrument.

There are two models, one for use on the bench, and a portable model which may be used on work still in the thread cutting machine, without removal.

The bench model handles screws up to 6″ in diameter and 30″ in length. The portable model handles screws from 1″ to 4½″ in diameter or from 2″ to 6″. Twelve inches of screw is checked at one setting by either model. For screws longer than that more than one setting is made.

The principle of magnification is the well-known combination of Reed Mechanism and light beam lever, used in the Sheffield Visual Gage. The action of this mechanism is always positive, instantaneous and frictionless.

Write for descriptive literature



SHEFFIELD
GAGE CORPORATION • DAYTON, OHIO, U.S.A.
MASTER GAGEMAKERS

TRADE PUBLICATIONS

ABRASIVES The National Metal Abrasive Co., 3560 Norton Road, Cleveland, Ohio, has just issued a new handbook, "The ABC of Cleaning, Hardening, Surfacing and Strain, Etc.," by controlled abrasives.

BLUEPRINTING MACHINE The C. F. Pease Co., 2601 W. Irving Park Road, Chicago, Ill., is circulating a four-page folder which provides specifications and illustrates the "22-16" blueprinting machine.

CASTINGS The Meehanite Research Institute of America, Inc., Pittsburgh, Pa., is circulating a 49-page booklet, "Meehanite in Industry", which contains a collection of articles concerning Meehanite castings.

COATINGS The Wailes-Dove-Hermiston Corp., Westfield, N. J., has just published Bulletin No. 1040, which describes the application of protective coatings for industry. "Bitumastic" enamels and cold applied coatings are described.

CONTROL ACCESSORIES General Electric Co., Schenectady, N. Y., is circulating Leaflet No. GEA-841K, which illustrates the construction and operation of magnetic starters and control accessories.

CONTROL PANELS John S. Barnes Corp., 301 So. Water St., Rockford, Ill., is circulating leaflets which portray the operation and construction of power and control panels.

CRANES A revised edition of the general hand-operated hoisting equipment, trolleys, and cranes catalog, No. 12-C, is being circulated by Wright Manufacturing Div., American Chain & Cable Co., Inc., York, Pa.

DIE CASTING The Phoenix Machine Co., 2711 Church Ave., Cleveland, Ohio, has just published an eight-page folder, No. 2-B-340, which includes general specifications, describes the construction and operation of the Phoenix-Lester die-casting machine.

ENGRAVERS Mico Instrument Co., Cambridge, Mass., is circulating an eight-page booklet which describes and illustrates a new small engraving machine.

FANS Wagner Electric Corp., St. Louis, Mo., is circulating a 20-page Bulletin, No. FU-41, which illustrates and describes the line of Wagner cooling and ventilating equipment for 1941.

FANS A 50-page bulletin, No. DS-348, which illustrates and describes a complete line of Trane fans, is being circulated by the Trane Co., La Crosse, Wis. The bulletin notes the capacities of

direct-connected utility blowers, belt-driven fans, and also provides standard arrangements and discharges.

GRABS Cleveland Tramrail Div., The Cleveland Crane & Engineering Co., Wickliffe, Ohio, has published an eight-page booklet, No. 2005-A, which gives information regarding overhead methods of materials handling. Operating features of a variety of grabs are described.

GRINDING EQUIPMENT T. C. M. Manufacturing Co., 300 First St., Harrison, N. J., is circulating Bulletin No. 409 which illustrates, provides prices and specifications, and describes operating features of the "All-In-One" equipment for grinding and lapping.

LIQUID GAGES Catalog No. 1015, which describes modern liquid level gages, is being circulated by the Bristol Co., Waterbury, Conn.

MACHINES Interstate Machinery Co., Inc., 109 So. Clinton St., Chicago, is circulating Catalog No. 393 which illustrates and provides operating data of all types of presses, drills, grinders, hammers, lathes, millers, motor drives, and planers. Over 2,000 new and rebuilt machines are in stock and described in the catalog.

MACHINES Atlas Press Co., North Pitcher St., Kalamazoo, Mich., has just published a 72-page booklet which includes complete information on 1941 models of Atlas lathes, drill presses, arbor presses, and shapers. Two new machines, a bench miller and a multiple spindle drilling machine, are described.

MACHINING PROBLEMS Gisholt Machine Co., Madison, Wis., has published performance data sheets outlining the practical solutions to various machining problems. Such problems as turning diesel engine injector bodies, turning automotive testing equipment parts, and machining steering clutch drums are discussed.

MILLING MACHINES Sundstrand Machine Tool Co., Rockford, Ill., has issued a four-page leaflet which provides construction specifications, operating data and dimensions of the company's hand feed Rigidmil.

MIXING MACHINERY A 24-page catalog is being circulated by the Eastern Engineering Co., 45 Fox St., New Haven, Conn., which describes and illustrates mixing equipment for industrial applications.

MOTORS Pamphlet No. GEA-1868B, circulated by General Electric Co., Schenectady, N. Y., illustrates and describes in four pages the specifications and operation of electric motors.

SPECIALTY EQUIPMENT The De Vilbiss Co., Toledo, Ohio, is circulating a 44-page catalog which illustrates and describes, complete with specifications,

HARD JOBS MADE EASY ON THE DoAll

C. A. Weidner & Sons, Rochester, N. Y. are now able to do highly specialized metal cutting jobs that would be difficult, tedious and prohibitive in cost without their DoAll Machines.

Screw Machine Cams, averaging 3/8" thick and 8" diam. cut on a DoAll at Remington Rand, Inc., Elmira, N. Y.

Locking Cam and Cam Stop made of oil hardening tool steel cut directly on the DoAll (no die required) by Taylor Instrument Co., Rochester, N. Y.

Continental Band Filer

Does internal and external filing on all metals. Action is continuous, which means faster, better results. 21 file bands available, 1/2", 3/8" and 1/4" wide—flat, oval or half round.

SPEED UP

DEFENSE WORK

Time—that's what we're all working against, not only in our defense program, but in regular industrial production. Wherever metal is shaped, cut and used, the DoAll Contour Machine can effect surprisingly large savings in time, labor and material. It's today's indispensable tool.

NEW MODEL V-60

A brand new model with three 26" wheels, the third one to give it a throat 60" deep. Handles large size and odd shaped metal parts and products.

Four of these are in use at the Canadian General Electric Co.

Investigate the DoAll immediately. Let us send a factory trained man to your plant to show you what a DoAll can do for you.

NEW DoAll GRINDER with Hydraulic Table Movements

A super precision surface grinder—a real production tool. Less vibration because motor is built right on ball-bearing spindle. Work table travel is infinitely variable, up to 50 f.p.m., and has exceptionally large bearing surface.

FREE—Ask for Literature on all DoAll Machines, or 158-page Handbook on Contour Machining.

CONTINENTAL MACHINES, INC.

1310 S. WASHINGTON AVE. MINNEAPOLIS, MINN.

In Grinding

DON'T OVERLOOK THIS VERY IMPORTANT FACTOR!

Stuart's CODOL

Liquid Grinding Compound

100% grinding efficiency is best accomplished by careful consideration of the grinding fluid factor. The vital part which a properly applied, specialized grinding lubricant plays is too often overlooked. It can mean unnecessary sacrifice in quality of finish production speed, and cost of wheels.

These handicaps can frequently be eliminated by going over your grinding problems with a STUART OIL Engineer. His highly specialized experience in the application of modern grinding fluids will help you secure top efficiency.

ASK FOR this informative booklet. Free working sample upon request. Please send your name on Company Letterhead.

Be sure to visit the Stuart Oil Exhibit — Booth 174, at the 1941 Machine Tool Progress Exhibition, Detroit, March 24-29.

For All Cutting Fluid Problems

D. A. STUART OIL CO. LIMITED

Chicago, U.S.A. Est. 1865

Warehouses in All Principal Metal Working Centers

sizes and prices, various automotive, portable and specialty equipment. Such items as air compressing equipment, air tanks, liquid spray guns and transformers are included.

SPRAY MACHINES Binks Mfg. Co., Chicago, Ill., is circulating loose-leaf Catalog No. 78 which illustrates and describes spray painting and finishing equipment.

STANDARDS "Index to A.S.T.M. Standards, Including Tentative Standards," a bulletin published by American Society for Testing Materials, 260 So. Broad St., Philadelphia, Pa., gives information on all of the 952 standards as of Dec. 1, 1940. Copies of the 172-page publication are furnished without charge.

TRANSMISSIONS—Reeves Pulley Co., Columbus, Ind., has published a 124-page catalog on Reeves speed control. The catalog describes the operation and application of variable speed control units.

TOLERANCES The American Standards Association, 29 West 39th St., New York, N. Y., has just published a 24-page pamphlet, "Tolerances for Cylindrical Fits," which explains the principles underlying the setting up of a standard system of fits, the control of fits by means of limit gages, and the accuracy requirements for the gages themselves. Price, 25 cents.

NEW BOOKS

TEMPERATURE. *Its Measurement and Control in Science and Industry—1362 pages. Published by the Reinhold Publishing Corporation, 330 West 42 St., New York, N. Y. $11.*

Temperature is often considered something to talk about when all other conversation languishes. But temperature as presented here means a lot more than such casual remarks as, "I think it feels a little warmer today."

The basis of this text is a symposium held in New York City during November, 1939, under the auspices of the American Institute of Physics in cooperation with the National Bureau of Standards and the National Research Council. Officers and committees of twelve technical societies worked on the program. To compile the record as it stands in this volume, they spent a tremendous amount of time and effort. The thirteen chapters can be divided in general under two headings: scientific consideration of temperature in the abstract, and particular applications to specific branches of industry. Such range of treatment gives us papers, on one hand, concerning the "Reproduceability of the Ice Point," having general scientific value, and papers, such as "Thermometers for Aircraft," having timely application.

Included with the papers are discussions which were developed at the time the symposium was held. For convenience of the reader, bibliographies are placed at the ends of individual papers, but 25 tables of generally useful data and a glossary of terms are found in an appendix. Many topics have been brought up to date.

•

MECHANISM—*By Stanton E. Winston, associate professor of mechanical engineering, Illinois Institute of Technology. 372 pages. Published by American Technical Society, Drexel Ave. at 38th St., Chicago, Ill. $3.50.*

Mechanism deals with the motion of machine elements as distinct from considerations of strength, wear and rigidity. When proportions of machine parts are considered, one departs from a study of mechanism into that of machine design.

Machine elements are many and varied. If dealt with type by type, their description might lead to complication and confusion. The author has avoided such devious treatment by putting emphasis on the fundamental theory of his subject. He handles transmission of motion by taking up in turn a limited number of types of mechanism. His analysis of them is graphical rather than algebraic.

In his treatment of the theory of motion, Professor Winston develops the basic subjects of instant centers, relative velocities and velocity diagrams. He then discusses the three ordinary modes of transmission: linkwork, wrapping connectors and direct contact mechanisms.

Each chapter is followed by a series of questions and answers for convenience in using this volume as a textbook. This text is designed to supplement the author's *Machine Design.*

•

ANALYTICAL MACHANICS FOR ENGINEERS—*By Fred B. Seely and Newton E. Ensign. Third Edition. 450 pages. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York. $3.75.*

Written to present those principles of mechanics that are believed to be essential for the student of engineering, this book is aimed to make the principles of mechanics stand out clearly. These principles are built up as much as possible from common experience and are applied to concrete problems of practical value. The principal changes in the third edition of this book consist of the addition of a number of new problems and figures, some reduction in the text discussion in the first three parts, and the addition of a new chapter on mechanical vibrations in the fourth part. The book has been completely reset, and many detailed changes in the presentation of the subject have been made for the purpose of giving special emphasis to various ideas, concepts, and principles that experience has shown are especially difficult for the student to grasp.

Likewise, several comprehensive illustrative problems have been added, particularly in the sections on Statics and Kinetics, for the purpose of emphasizing the importance of a general method of attack in applying the principles of mechanics to the solution of problems.

The book is divided into four parts; namely, Statics, Kinematics, Kinetics, and special topics. The fourth section consists of a group of special topics somewhat more advanced than those treated in the first three parts. They include discussion of such subjects as mechanical vibrations, balancing, the gyroscope, further study of the acceleration of a point, and a chapter on governors.

Both kinetics and kinematics have been developed with regard for the increasing importance of dynamics to engineers. The geometric and physical conceptions and interpretations of the quantities in kinematics have been emphasized rather than the mechanical conception. The treatment of kinetics has been restricted to the more common types of motion found in engineering practice, but these motions have been treated more fully than is usual in elementary texts on mechanics. This is particularly true of plane motion. Graphical methods of representation and of solution have been used frequently throughout the book. A knowledge of elementary calculus is assumed.

•

THE METALLURGY OF DRAWING AND PRESSING—*By J. W. Jevons, 699 pages. Published by John Wiley & Sons, 440 Fourth Ave., New York. $10.*

Here is a subject in which practice has preceded theory. Because of the rapid growth in the use of sheet metal in the automobile and aircraft industries, the shop man has been compelled to use his ingenuity in solving the urgent problems inherent in their drawing and pressing.

That he has succeeded admirably without what is commonly called "scientific" help is no reason why this important branch of the metal-working industry should not catch up with itself. Dr. Jevons' book should help it to do so.

Drawing and pressing represent a new branch of metal-working. It is true that since early times, metal sheets were hammered out and skillfully fashioned as exemplified by the body armor worn in the middle ages. However, these products were made by hot or cold forging operations which cannot be compared to the mechanical tooling of modern metal-working presses.

Dr. Jevons' book devotes much space to the practice as well as to the theory of these operations. It is intended both for the student and the practical shop man. Indeed, if it brings these two groups together, it will perform a signal service in the advancement of an art that until now has progressed too fast to take stock of itself.

LUFKIN TOOLS WILL HELP SPEED UP PRODUCTION....

Like many another product, the Precision Tool of 1941 is a great improvement over its predecessor of only a few years ago. Outstanding among advancements made in recent years are the new Lufkin Universal Indicators, Master Planer Gages, and improved Micrometers. Developments in these tools — to take only a few examples — permit you to do not only a better job, but to do it faster and with less chance of costly error. So keep pace with the speed of 1941 — use 1941 tools — use Lufkin Precision Tools.

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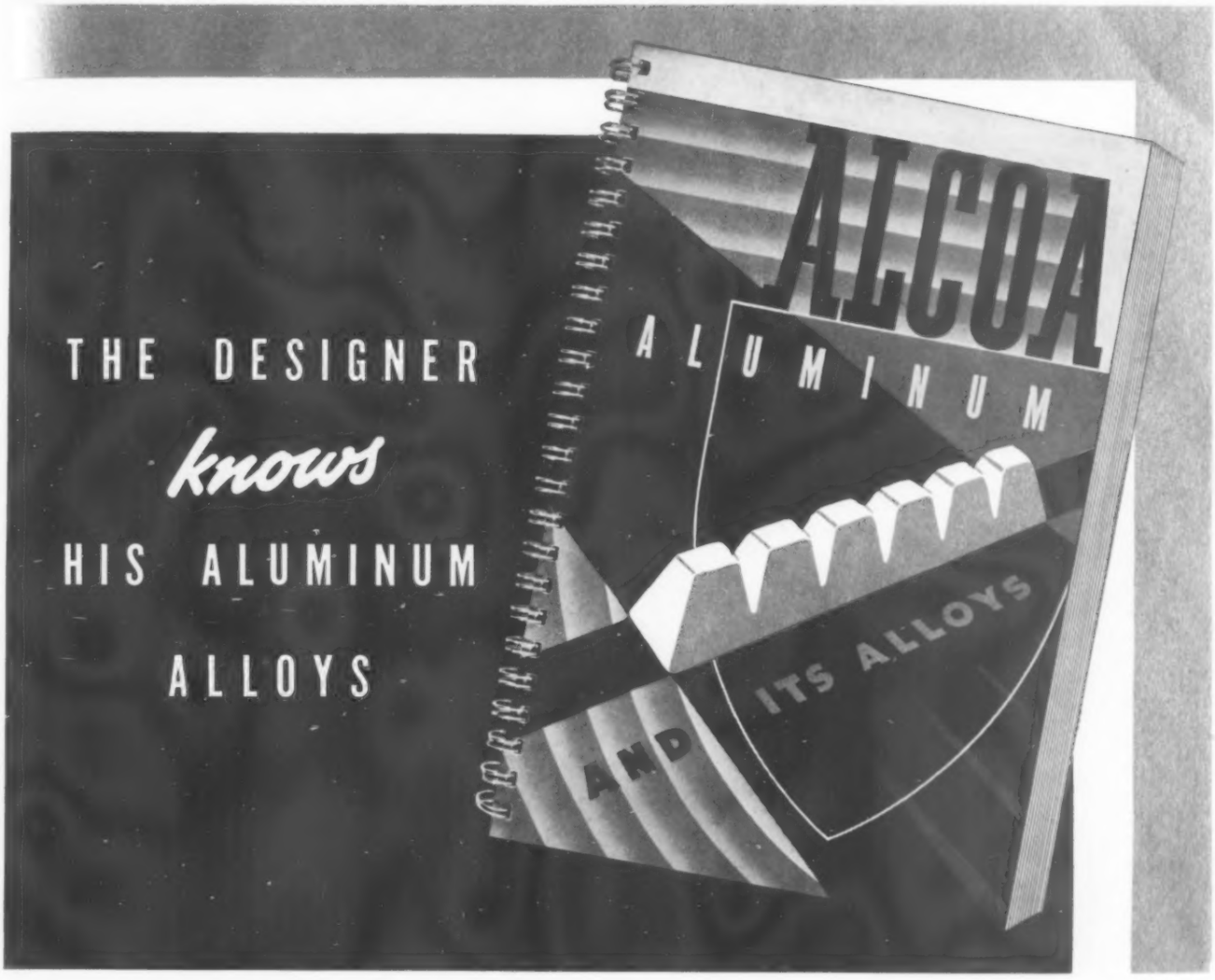
You'll find plenty of Aluminum Alloy forgings, little fellows like these, doing man-sized work. Their high strength-weight ratio and uniformly sound metal qualify them for such tough jobs as these; trowel handle supports, shift levers, handle bar extensions, spray gun housings, hardware and racing horseshoes.

Alcoa Aluminum forgings are held to close dimensional tolerances. Parts can be quite complicated, eliminating many machining and assembly operations, with the result that manufacturing costs are less. Surfaces are smooth, so forgings take a fine finish. Forgings are highly resistant to corrosion.

Alcoa Aluminum forgings are made in a variety of alloys, suiting their characteristics to the requirements for the parts. ALUMINUM COMPANY OF AMERICA, 2107 Gulf Building, Pittsburgh, Pa.

ALCOA ALUMINUM



You wouldn't just order "meat" when you're all set for a juicy steak. You'd probably say "porterhouse," surrounding it with plenty of specifications about that steak and how it's to be prepared. Designers, in drawing up material specifications for the manufacturer, are equally "choosy" in selecting Aluminum Alloys. They know from available Alcoa data, or through their own experience, what to expect of certain alloys. If it's a new job, they may set various alloys to work, exposing them to conditions simulating actual service.

As a starter in building up your data file, you should have the book, "Alcoa Aluminum and its Alloys." It covers this broad field in a concise but comprehensive manner. For a copy of this book, write ALUMINUM COMPANY OF AMERICA, 2107 Gulf Building, Pittsburgh, Pennsylvania.

DEFENSE COMES FIRST

To meet the needs of the National Defense Program, plus the normal demands of peace, a vast expansion of our already greatly increased production capacity is being speeded. When the emergency is past, there will be more Aluminum available than ever before.

Meanwhile, if you can't get all the Aluminum you want when you want it, remember Aluminum is helping you by helping to meet the National emergency.

ALCOA ALUMINUM

The Illinois Metal-Working Industries Take Emergency Demands in Their Stride

Everybody's *talking* about "bottlenecks." Most "bottlenecks" are shortages of tools or parts which occur where Industry is not accustomed to meeting peak demands. In the Metal-Working Industries, Illinois manufacturing and fabricating plants are used to, and ready for, stepped-up production.

Illinois is one State where normal production schedules are based on a constantly increasing volume of output. Expansion is the rule and where growth is expected, it is provided for. Plant facilities are flexible. Management is adaptable to change. Skilled labor is trained in a greater variety of trades and occupations.

Illinois is the center of tool production. The "bottlenecks" which are apt to arise in many localities are less likely to occur in Illinois.

To Metal-Working Industries seeking the best location for new factories or branch plants—and to contractors serving the National Defense Program—the Illinois Development Council offers complete cooperation in furnishing data on plant sites, availability of labor, materials, and other facilities of production or distribution.

Write today for a special confidential report giving full details regarding Illinois advantages which apply to your business. Your inquiry will, of course, be kept strictly confidential. Write—

Illinois Development Council • State House • Springfield, Illinois

ILLINOIS

THE STATE OF BALANCED ADVANTAGES

Illinois has more than 2,300 metal-working plants, with over 300,000 skilled workers.

Illinois leads in the midwest in metal-working. Annual production totals $3,000,000,000.

DIES STAY CLEAN... SCRAP REDUCED WITH STANOSTAMP

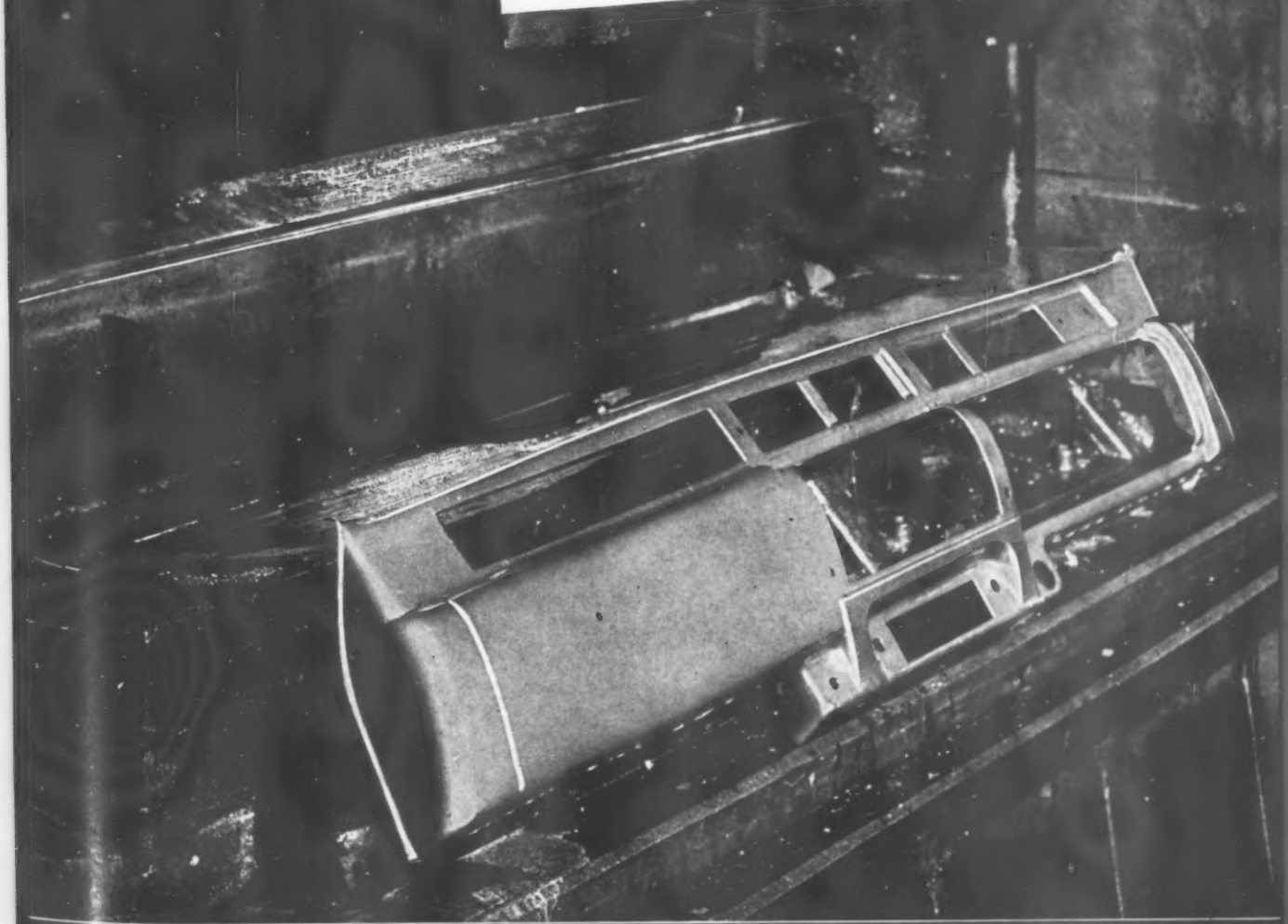
● MINOR adjustments and changes are to be expected where a new deep drawing operation is being set up. But when the production engineer in a Michigan plant found it necessary to scrap up to 40% of the auto dash panels turned out on one machine, he was almost convinced that it would be cheaper to throw away the dies and start over.

After testing many drawing compounds and oils, the dies still became loaded and the scrap pile grew. He was about to change the job to do it in two operations, when a Standard Oil Engineer learned about the problem. A test of Stanostamp was arranged.

Without any other change the dies functioned perfectly, loading was eliminated, and scrap dropped to about 1% with Stanostamp.

Before making any radical changes in troublesome stamping or machining operations, let a Standard Oil Engineer make his recommendations. You can't lose. This service costs nothing. Just call the local Standard Oil (Indiana) office, or write 910 South Michigan Avenue, Chicago, Illinois for the engineer nearest you.

Copr. 1941, Standard Oil Co. (Ind.)



STANDARD OIL COMPANY (INDIANA)

CATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINE

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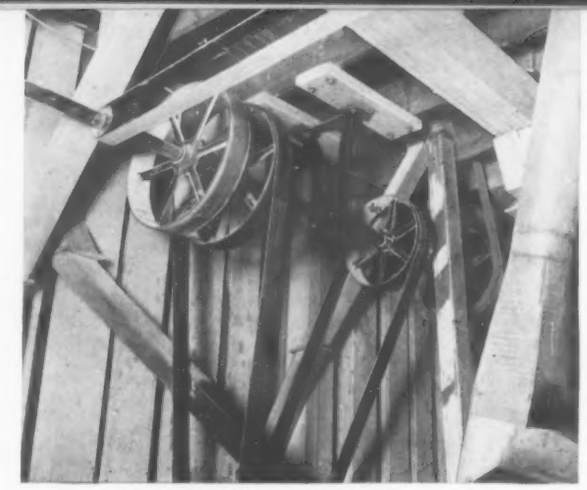
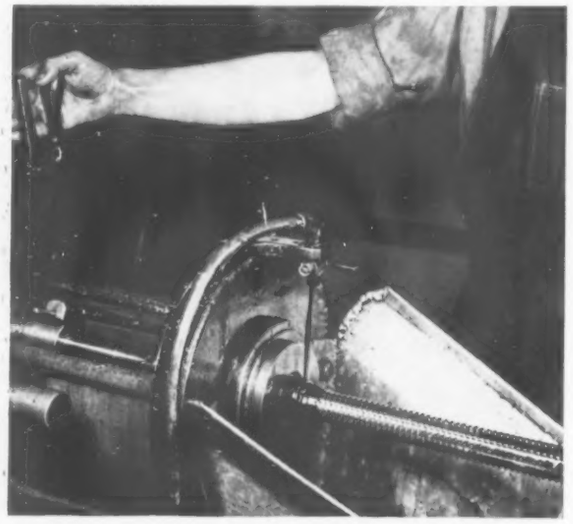


STANODRIP CUTS OIL COSTS IN HALF...STOPS OIL LEAKAGE

Many "cure-alls" were tried at an Illinois milling plant to eliminate hot bearings and leakage when ordinary red engine oil was used to lubricate line shafting, mill rolls and sifters. A tallow product was tried, but high bearing temperatures persisted. Then an expensive non-fluid oil was used. That solved the problem, but lubricating costs jumped. Finally Stanodrip was tested at the suggestion of a Standard Oil Engineer. It also eliminated overheating and leakage, but at *half the cost* of the "special" product.

If you have any bearing lubricating problem, try the Standard Oil Engineer first. It will save you a lot of time experimenting and may save a great deal more in lubri cant and maintenance costs.



ACME CUTTING OIL FOR LONG TOOL LIFE

Acme Cutting Oil is a high production oil. It is highly sulfurized. That means that it reduces friction between the tool and the work. As a result, tools stay sharp and finish is improved. It also means that there are fewer interruptions of production for tool grinding and setting. Acme has made these economies on many types of production jobs in broaching, drilling, hobbing, etc. Why don't you select one job in your shop? Let a Standard Oil Engineer recommend the grade of Acme that he thinks will reduce costs. Then watch what happens.

WHEEL LOADING...RUSTING ...STOPPED WITH SUPERLA SOLUBLE OIL

A certain Indiana foundry and machine company was having just about all the trouble anyone could have with an emulsified cutting oil.

A Standard Oil Engineer was asked to find out what could be done. He knew that wheel loading is frequently caused by a rich mixture of soluble oil or by an unstable emulsion, and that rusting is caused by a lean mixture of soluble oil or by the poor rust preventive quality of the oil. He knew Superla Soluble Oil would end all these troubles because it forms a uniform stable emulsion even

in hard water. This would prevent wheel loading. It could be used in comparatively lean mixtures and still secure adequate rust protection.

And that is just what happened when Superla Soluble Oil took over machining operations in this foundry.

NOW, MORE THAN EVER, YOU NEED A STANDARD LUBRICATION ENGINEER

When stepping up the output on machining operations, don't overlook your cutting oil. Products that have been economical under normal conditions may prove costly when equipment is pushed to capacity. Let a Standard Oil Engineer help you check this highly important side of your production problem today. His knowledge of cutting lubricants may save you many hours of experimenting. Call any Standard Oil Company (Indiana) office or write 910 South Michigan Avenue, Chicago, Illinois. In Nebraska, write Standard Oil Company of Nebraska at Omaha.

IN THE DARK ALL CATS ARE BLACK

... *in the bright light of performance*

Vascoloy RAMET

T. M. REG. U. S. PAT. OFF.

Tantalum-Tungsten Carbide Tools

PROVE *their worth... at* LOWER *cost*

If you buy in the dark you must expect less than you pay for.

This is particularly true in the purchase of carbide tools—especially today.

This fact is irrefutable: Wherever outstanding jobs of steel cutting are being done today, Tantalum Carbide tools are doing them. And of all brands of Tantalum Carbide, Vascoloy-Ramet Tantalum-Tungsten Carbide tools are doing the best job.

For instance, in many important plants the majority of steel being cut today is being cut with Vascoloy-Ramet Tantalum-Tungsten Carbide Tools.

This is because the Fansteel Metallurgical Corporation and its associated and affiliated companies have "fathered" the scientific research and development which has resulted in the best carbide tools available.

These scientists, working with the crude ores, were the first to blend a carbide that would cut steel—Tantalum Carbide, which, because of its low coefficient of friction, eases its way through tough steel with less tool wear, cratering and chip wear and consequent longer tool life and lower cost.

Furthermore, Fansteel pioneered and developed the use of pure Tantalum in this country; is one of the largest producers of pure Tungsten; and has the largest staff of research scientists in the field of powder metallurgy.

In Vascoloy-Ramet tools you have all the combinations of Tantalum Carbide, Tungsten Carbide, Tantalum-Tungsten Carbide, Titanium Carbide, plus all the grades and basic shapes necessary to meet any metal cutting problem.

The combination of the engineering skill of the Vascoloy-Ramet Corporation; Fansteel's scientific research; the standing of its associate company, Vanadium-Alloys Steel Company, and the broad experience of leading tool manufacturers who are authorized Vascoloy-Ramet agents, assure you excellent cooperation and service.

This manual tells the entire story of Vascoloy-Ramet tools and blanks; their available grades and shapes and suggestions for their use. Send for it.

VASCOLOY-RAMET CORPORATION
North Chicago, Illinois
an affiliate of
VANADIUM-ALLOYS STEEL COMPANY
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and
FANSTEEL METALLURGICAL CORPORATION
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Whether you are making

FIGHTING PLANES *or* ROLLER BEARINGS

Use these made-to-measure steels to insure dependable performance—make fabrication easier—keep costs down.

THERE are good reasons why we are able to make these claims for U·S·S Carilloy Alloy Steels.

First of all, the making of Carilloy Alloy Steels is with us a precise and exacting process in plants which make a specialty of alloy steel production. Here, the finest and most modern equipment is matched by the skill of experienced mill and metallurgical personnel, and every order, whether large or small, receives individual care and attention.

Secondly, we go a long way to dig out the facts that forecast the behavior of U·S·S Carilloy Alloy Steels. Steels that are destined for especially severe or unusual service are subject to a program of investigation which may go far beyond that ordinarily required to determine quality.

Finally, to help you fit the right steel to your needs with the least trouble, waste, and delay, the expert assistance of our metallurgical contact men is always available. These men know steel. They are familiar with the steel problems of many different industries. They can competently advise you in the most advanced shop methods of using steel. If you are treading strange, new paths in your manufacturing today, their assistance can be invaluable.

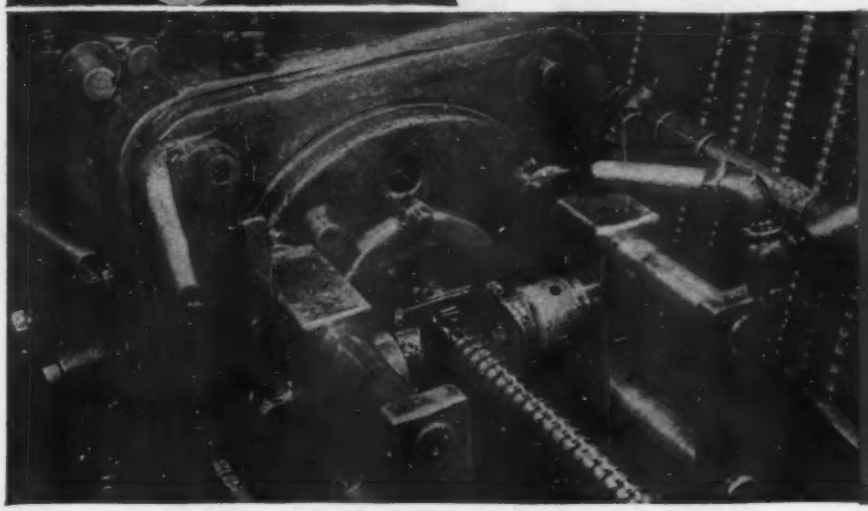
U·S·S CARILLOY *dependable* ALLOY STEELS

CARNEGIE-ILLINOIS STEEL CORPORATION
Pittsburgh and Chicago

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL

THE BROACH STAYS Cool!



OIL GEAR BROACHING MACHINE and the universal-joint forging in which it broaches a 5½" splined hole . . . showing big improvements over previous coolant, plus a 20% increase in broach life. Texaco *Sultex Cutting Oil "DD"* used.

THEY PREFER TEXACO

★ More railroad rolling equipment in the U. S. is lubricated with Texaco than with any other brand.

★ More tourists use Texaco *Fire-Chief* Gasoline than any other brand.

★ More scheduled airline mileage within the U.S. and to other countries is flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More copper is produced in the U. S. by mines using Texaco Products than by all other copper mines combined.

★ More stationary Diesel horsepower in the U.S. is lubricated with Texaco than with any other brand.

★ More Diesel horsepower on streamlined trains in the U.S. is lubricated with Texaco than with all other brands combined.

BROACHING splined holes in this universal-joint drop forging, the chips *fall off,* the broach runs cool, the finish is better, with no welding, no tearing. The broach itself lasts 20% longer.

All this from the use of *TEXACO SULTEX CUTTING OIL "DD."*

This broaching job is typical of greatly improved results everywhere in cutting and grinding machining operations . . . using *TEXACO Sultex Cutting or Soluble Oils.*

The outstanding performance that has made Texaco preferred in the metal fabricating field has also made it preferred in the fields listed in the panel. Buyers in these fields are enjoying many benefits. You, too, will find important advantages when you use Texaco Lubricants and Fuels.

A Texaco Lubrication Engineer will gladly cooperate in increasing tool life in your shop. Phone the nearest of more than 2300 Texaco distributing plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York, N. Y.

TEXACO DEALERS INVITE YOU TO ENJOY

FRED ALLEN in a full-hour program every Wednesday night. CBS, 9:00 E.S.T., 8:00 C.S.T., 10:00 M.S.T., 9:00 P.S.T.

METROPOLITAN OPERA every Saturday afternoon, NBC. See local newspaper for time and station.

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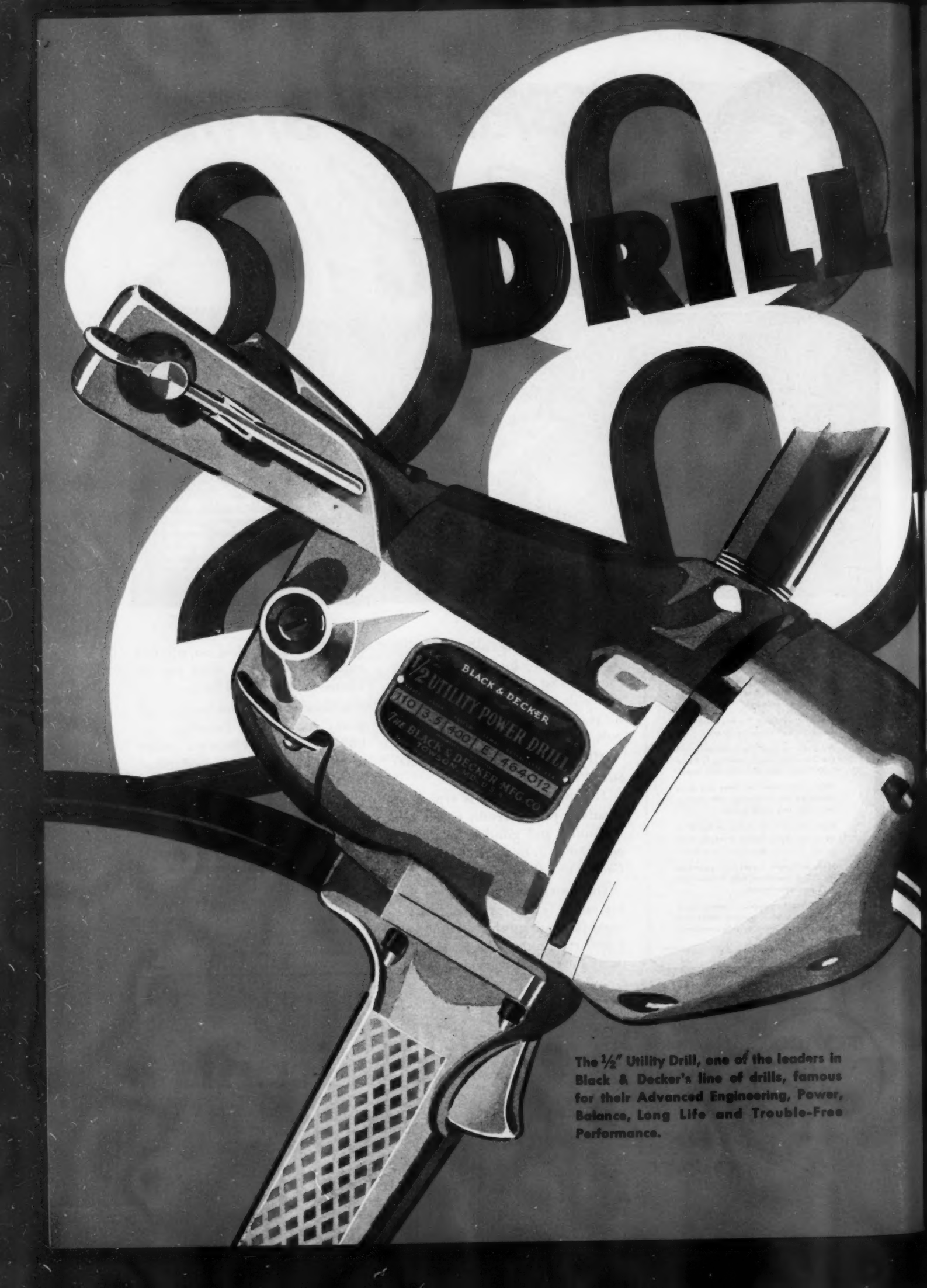
TEXACO Lubricants

AND METAL-CUTTING COOLANTS



The 1/2" Utility Drill, one of the leaders in Black & Decker's line of drills, famous for their Advanced Engineering, Power, Balance, Long Life and Trouble-Free Performance.

MODELS
TO FIT EVERY JOB
Backed by a Name you can Trust

Complete Black & Decker Line Offers Drills with the Exact Power, Speed, Grip, Chuck, Shape and Size You Want . . .

FROM this palm-sized 3/16" Hornet weighing only 34 ounces —

TO this two-man 1½" Heavy Duty Drill and Reamer

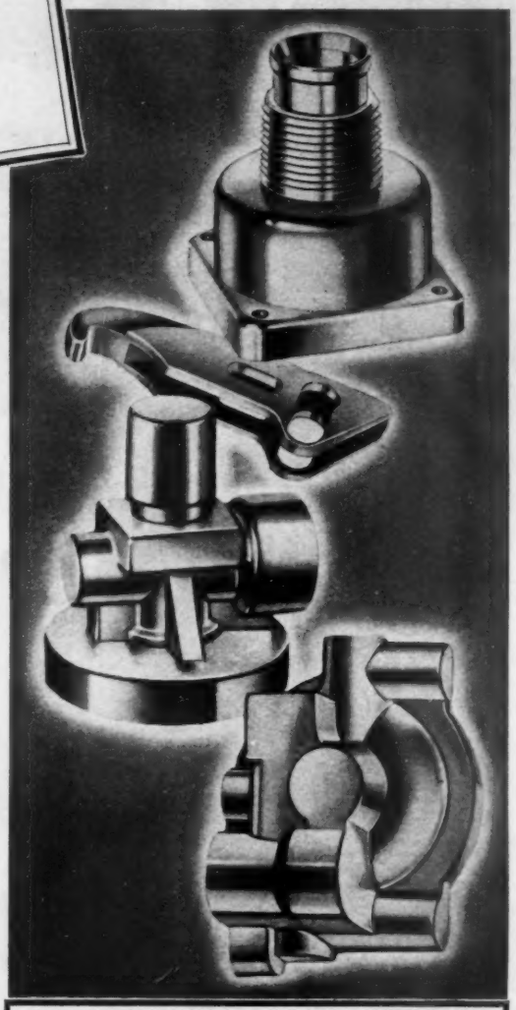
LET YOUR DISTRIBUTOR HELP YOU select Black & Decker Drills of the right type and size to fit your kind of Drilling. Then put them to work—with full confidence that you have the finest drills for the job that money can buy. For over a quarter of a century the quality and dependability of Black & Decker Drills have been a demonstrated fact wherever electric tools are used. Ask your distributor to demonstrate the right Black & Decker Drills for your work, or wire The Black & Decker Mfg. Co., 716 Pennsylvania Ave., Towson, Md.

LEADING DISTRIBUTORS EVERYWHERE SELL

Black & Decker
PORTABLE ELECTRIC TOOLS

SPEEDING PRODUCTION with McCASKEY TOOL CONTROL

Representative pieces of the thousands of brass forgings manufactured by Mueller Brass Company



"THE use of McCaskey Tool Control saves hundred of hours a week for our set-up men, machine operators, machines and crib attendants and has enabled us to materially reduce our crib inventory." This is the statement of Mr. F. R. Lewis, Tool Supervisor, Mueller Brass Company, Port Huron, Mich. He continues:

"Since we machine an infinite variety of screw machine parts and brass forgings, more than 3000 tools move in and out of our crib daily. All are specially designed and most of them are used in several set-ups. Some for as many as fifty different parts.

"It is most important for us to be able to locate every tool in our shop without delay. The adoption of McCaskey has eliminated the costly non-productive time frequently wasted by both men and machines, while missing tools were located. Improved service to our customers, particularly on rush and emergency jobs, is another result.

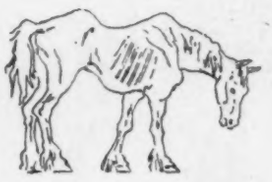
"The Control also provides a monthly turnover record for each tool that indicates the tools and quantities of each to be reordered. The data is easily secured and it removes all guesswork from this important job. As a result our inventory has been substantially cut, but we know that we are carrying sufficient stock for our top requirements.

"Other advantages further justify our installation of McCaskey Tool Control, but these savings alone have repaid our investment many times over."

You *know* what tools you need with McCaskey, no more no less. You *know* where every tool is, can locate them in a few seconds; no lost time for machines and men. No loss or theft and much less breakage. Easily installed in the busiest crib. Surprisingly inexpensive. Speed-up your production with McCaskey. Write today for facts.

THE McCASKEY REGISTER COMPANY
ALLIANCE, OHIO

McCASKEY INDUSTRIAL CONTROLS
PRODUCTION • INVENTORY • MAINTENANCE • TOOLS • COSTS • PAYROLL



When to change horses . . .

In steel, any time your production curve starts to look "sway backed"—it's time to change!

Are your production facilities fully energized with correct steels or are they suffering from an operating problem that's starving for lack of quality steels and steel uniformity? Regardless of how serious your situation is, a change to WYCKOFF Cold Drawn Steels is a tonic that will definitely straighten-out that production curve.

When should you change? Any time. The easy working qualities and strict uniformity of WYCKOFF Steels make every operation easier—faster—and once tooling is set—it stays set and produces.

Make the change to WYCKOFF Cold Drawn Steels for ten days and notice the improvement—then standardize for production. It's available to you from WYCKOFF distributors in all principal cities and from complete mill stocks in both Pittsburgh and Chicago. Change now to WYCKOFF!

DRAWN FROM Controlled STEEL

WYCKOFF
DRAWN STEEL COMPANY
First National Bank Bldg., Pittsburgh, Pa.
3200 So. Kedzie Avenue, Chicago, Illinois

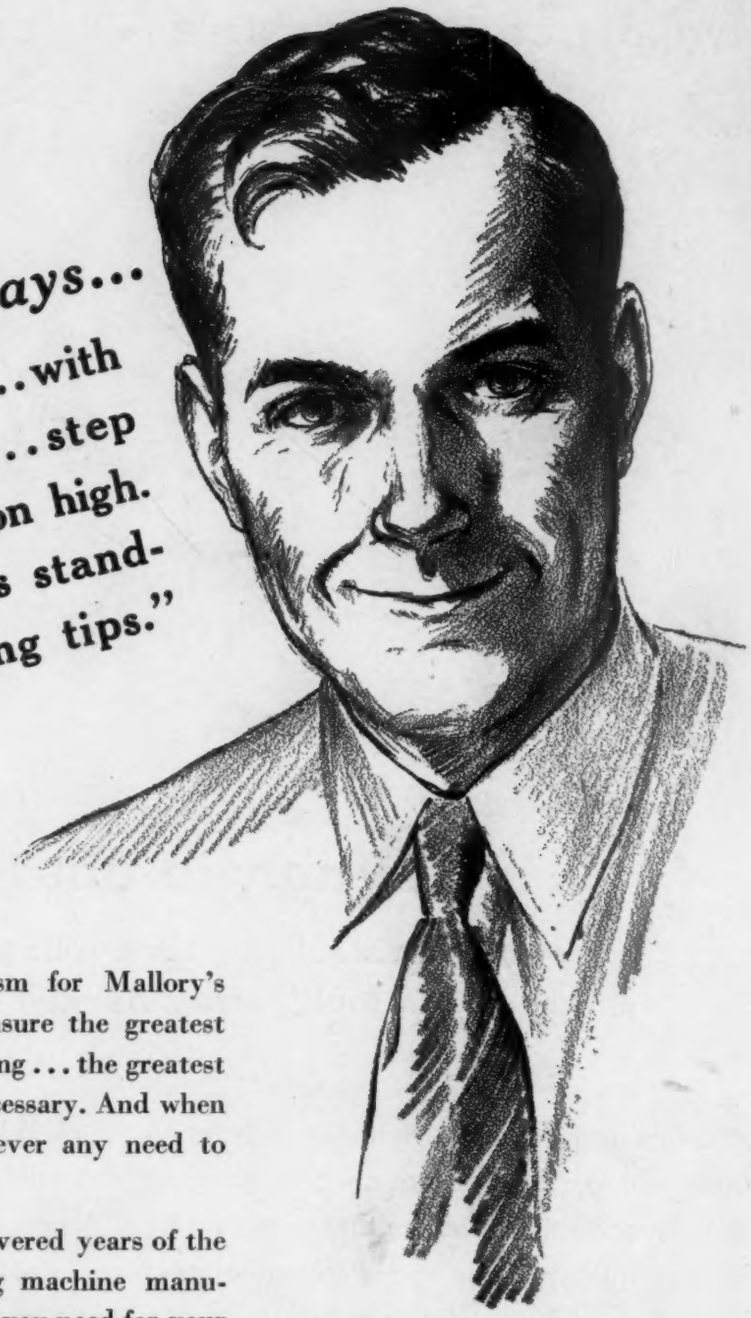
Mills at Ambridge, Pa., and Chicago, Ill.
Warehouse Stocks in Principal Cities

Manufacturers of Carbon and Alloy Steels..., Leaded Steels... Turned and Polished Shafting. .Turned and Ground Shafting ... Wide Flats up to 12" x 2"

COLD FINISHED STEEL
WYCKOFF

The Shop Foreman Says...

"I've watched our shop... with the same operators... step up to a new production high. Thanks to Mallory's standardization of welding tips."

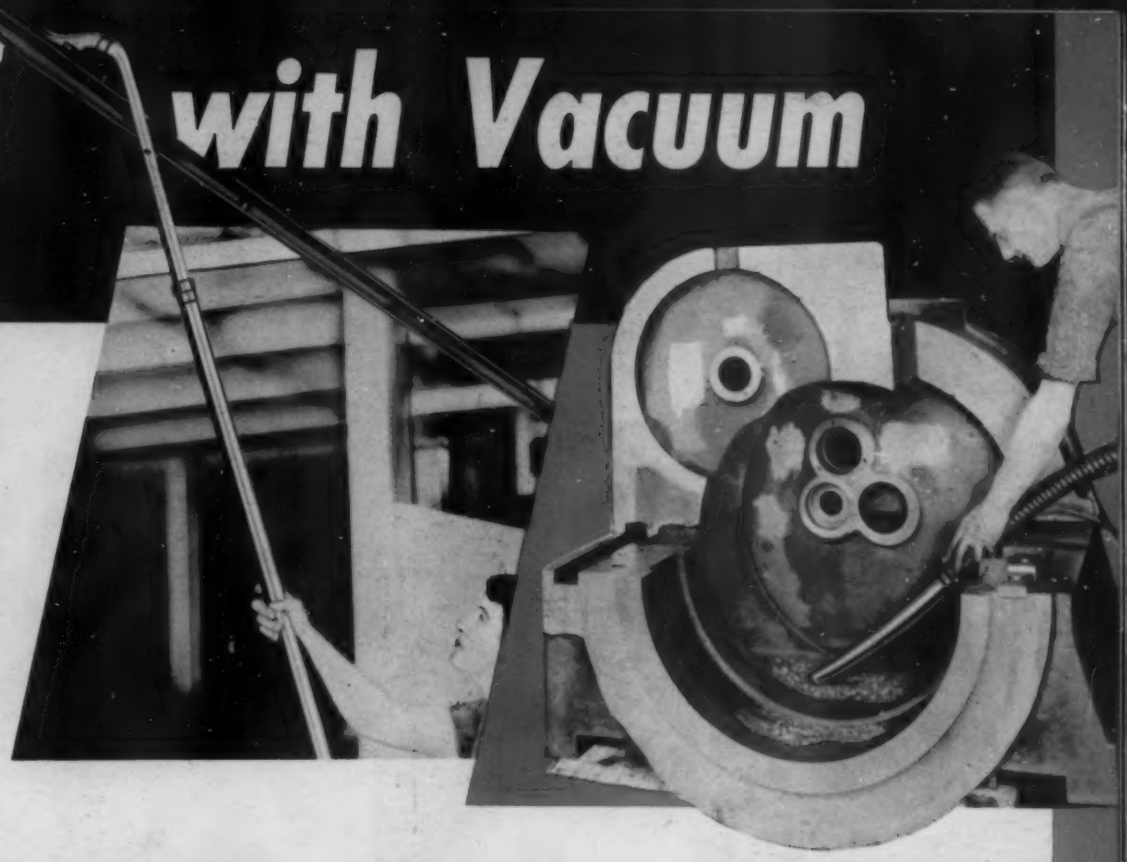


All along the line you'll find enthusiasm for Mallory's standardization of welding tips. They insure the greatest possible number of welds between re-dressing... the greatest possible number before replacement is necessary. And when replacement must be made... there's never any need to wait for special orders to be completed.

Mallory's standardization program has covered years of the closest cooperation with leading welding machine manufacturers. You can be sure of the exact tip you need for your purpose and machine. Why not cash in on the investment Mallory has made to insure better, cheaper welds?

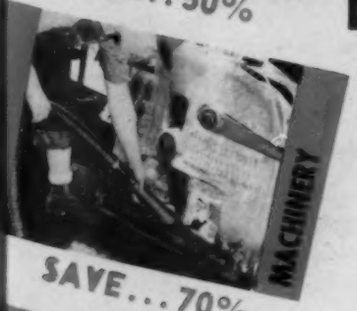
P. R. MALLORY & CO., Inc.
INDIANAPOLIS INDIANA
Cable Address—PELMALLO

SAVE with Vacuum



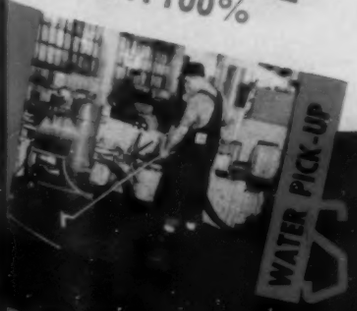
SAVE... 25%

SAVE... 50%



SAVE... 70%

SAVE... 100%



Is Your Mop-Up Squad Prepared?

Haste makes waste—a lot of waste in these times. Waste underfoot, overhead, in the machines and valuable metal chips, paints and powders that can easily be reclaimed.

Just one of the applications on this page may easily save the cost of a Spencer vacuum system in a few months. It is estimated that 80 per cent of the plants in the country could use vacuum cleaning either for reclamation of materials, reduction of fire, explosion and health hazards, or to speed up production. There is a unit of the proper size and dirt capacity for your plant. Sizes range from ¾ to 40 H.P. in the portable units and up to 100 H.P. in the stationary system.

DEMONSTRATION WITHOUT OBLIGATION

It is not necessary to guess or speculate. A Spencer portable can be placed in your plant within a few days. A demonstration of its ability to save time, materials, men or machines will prove its value.

A Trial Without Obligation—Use the Return Postcard

SPENCER
HARTFORD

STATIONARY AND PORTABLE VACUUM CLEANING SYSTEMS
THE SPENCER TURBINE CO. • HARTFORD, CONN

THE SPENCER TURBINE CO.
Hartford, Conn.

Please send me your booklet on Industrial Cleaning ☐ and any special information on the following subjects:

RECLAIMING METALS	☐	FLOOR CLEANING	☐
DUST PREVENTION	☐	OVERHEAD CLEANING	☐
WASTE REMOVAL	☐	MACHINERY CLEANING	☐

Please have representative call ☐. We would like to discuss a demonstration without obligation ☐.

Name_____

Company_____

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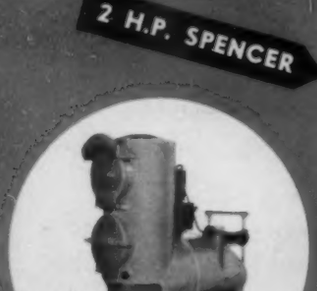
M

VACUUM

SPEEDS UP
CONSERVES MATERIAL
SAVES MAN POWER

1½ H.P. SPENCER

2 H.P. SPENCER



5 H.P. SPENCER

40 H.P. SPENCER

WATCH THE MAN WITH THE HOSE

He is your first line of defense against waste time, waste materials and the principal hazards of your plant. He can vacuum clean large areas at less cost, remove dirt and dust before painting, or move sand, metal chips, soapstone by the ton.

And he can clean greasy floors, get inside your most complicated machinery with a powerful vacuum, or pick up the finest dust in your precision departments.

Watch this man and what he is doing for others because he is probably coming to your plant.

In many cases the cost of the vacuum cleaning equipment is paid for in a few months.

We prefer to study your problem on the spot, and select the right power, dirt capacity and tools for the job at hand. We can reach conclusive results with a Spencer Portable for test purposes even though a stationary system may be the best suited to your needs.

USE THE RETURN CARD NOW. IT COSTS EXACTLY NOTHING TO FIND OUT WHAT SPENCER VACUUM CAN SAVE IN YOUR PLANT

FIRST CLASS
Permit No. 221
(Section 510, P.L. & R.)
HARTFORD, CONN.

BUSINESS REPLY CARD
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STATIONARY AND PORTABLE VACUUM CLEANING SYSTEMS
THE SPENCER TURBINE CO. • HARTFORD, CONN.

Machined ENDURO Keeps the Heart of the Aircraft Engine Beating Steadily

This pressure regulator valve, machined from Republic Enduro Stainless Steel bar stock, keeps fuel flow at constant pressure from the fuel pump to airplane motors.*

To the Metal Working Industries it is not news that the present demand for steel is enormous. Industry will do its share of carrying forward the National Defense program. At the same time it must provide for the needs of a nation with the world's highest standards of living. All this requires large quantities of steel.

During its ten years of existence, Republic Steel has been constantly improving equipment, enlarging capacity, training men. Now this organization is setting new records for the production of steel...records of which our men of steel are proud.

In both mills and offices the men of Republic are doing their level best to serve the nation with *steel —first line of national defense.*

R. J. Wysor
PRESIDENT

There are plenty of cases where a pound of Republic ENDURO* is machined into many tiny parts for use in vital places—where abrasion, corrosion or heat would quickly ruin other materials—where only stainless steel can make the entire unit practical—where this long-wearing metal is worth its weight in gold. • Republic supplies ENDURO in hot rolled and cold drawn bars having up to 90% the machinability of Bessemer screw stock.

We have a series of technical booklets on the various types of ENDURO—and booklets on fabricating and on welding. Write for any or all of them.

REPUBLIC STEEL CORPORATION

Alloy Steel Division: Massillon, Ohio • General Offices: Cleveland, Ohio

BERGER MANUFACTURING DIVISION • CULVERT DIVISION • NILES STEEL PRODUCTS DIVISION
STEEL AND TUBES DIVISION • UNION DRAWN STEEL DIVISION • TRUSCON STEEL COMPANY

* Reg. U. S. Pat. Off.

REPUBLIC *Enduro* STAINLESS STEEL

SHEETS—STRIP—PLATES—BARS—RODS—WIRE—TUBING—BOLTS—NUTS—RIVETS

SIVYER STEEL

and HEVI DUTY FURNACES

Much of the quality of Sivyer Castings is due to the accuracy and uniformity of the heat treatment they receive. For more than fourteen years a Hevi Duty Electric Car Type Furnace has been a factor in establishing this high quality.

Write for descriptive bulletins of Hevi Duty Furnaces

HEVI DUTY ELECTRIC COMPANY

HEAT TREATING FURNACES HEVI-DUTY ELECTRIC EXCLUSIVELY

MILWAUKEE, WISCONSIN

ACHIEVEMENT

DERIVED FROM

Leadership

IN HOBBING GEARS AND SPLINES
FOR THE AUTOMOTIVE INDUSTRY

● The automotive industry has long been recognized as the "pace setter" for mass production and close accuracy so essential to the economical output of quality cars. It also has a reputation for selecting tools for maximum efficiency. Cleveland Rigid-hobbers share this recognition by producing 80% of all of the gears and splines hobbed in the automotive field. Surely the proved ability of Rigid-hobbers in meeting the demands of this exacting industry recommends them for use in other industrial plants where accuracy and high productive capacity is an established requirement.

THE CLEVELAND
HOBBING MACHINE
COMPANY

CLEVELAND . . . OHIO

Test Your Cutting Oils With a "Mike"

PRECISE WORK—MINIMUM REJECTS—TELL THE STORY!

WHEN YOU GET REJECTS . . . check up on your cutting oils!

The right cutting oil can make the difference. Your micrometer will quickly prove it.

Ask a Socony-Vacuum engineer to look at your toughest job. The cutting oil he recommends may result in important savings.

CALL IN Socony-Vacuum for

GARGOYLE

Lubricants

The Emblem of
75 YEARS' PIONEERING
in "Correct Lubrication"
1866-1941

WHEN YOU CALL IN SOCONY-VACUUM, you profit from these four important lubrication advantages:

1. SKILLED LUBRICATION COUNSEL of a Socony-Vacuum Man backed by 75 years' experience... greatest in the petroleum industry.

2. A COMPLETE LINE OF LUBRICANTS... a scientifically correct oil or grease for each and every job in your plant.

3. NEW LUBRICANTS ahead of new needs ...developed in close cooperation with machine builders by the famous Socony-Vacuum Research Laboratories.

4. HALF-A-MILLION CASE HISTORIES behind the recommendations of our engineers.

SOCONY-VACUUM OIL CO., INC.—Standard Oil of New York Division—White Star Division—Lubrite Division—Chicago Division—White Eagle Division—Wadhams Division—Magnolia Petroleum Co.—General Petroleum Corp. of Cal.

"Correct Lubrication"

GUN BROACHING BY LAPOINTE

FIFTEEN TIMES FASTER!

THIS BARREL

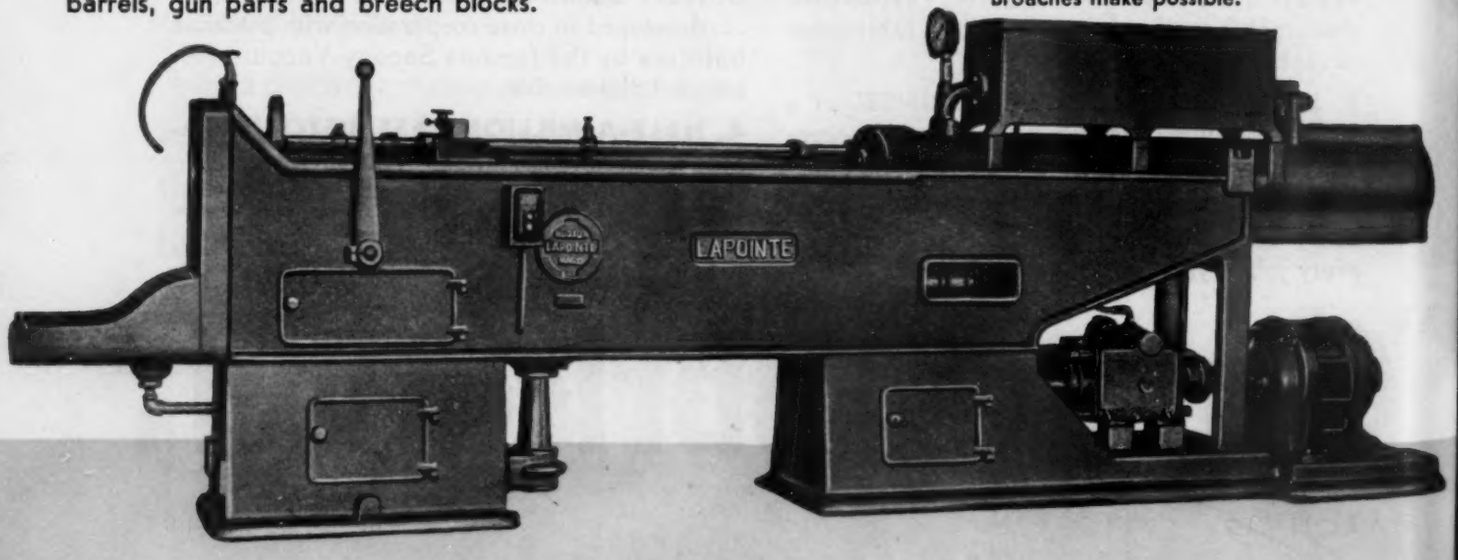
WITH

THIS BROACH

To rifle these Harrington & Richardson Reising Sub-Machine Gun barrels — being made for a "friendly foreign government" by the Harrington & Richardson Arms Co. of Worcester, Mass. — used to take fifteen minutes each. Now, with Lapointe equipment, the job is done in less than one. Using a standard Lapointe Horizontal Hydraulic Broaching Machine, a specially developed broach and an extremely simple fixture Lapointe engineers have put this formerly slow job on a high production basis.

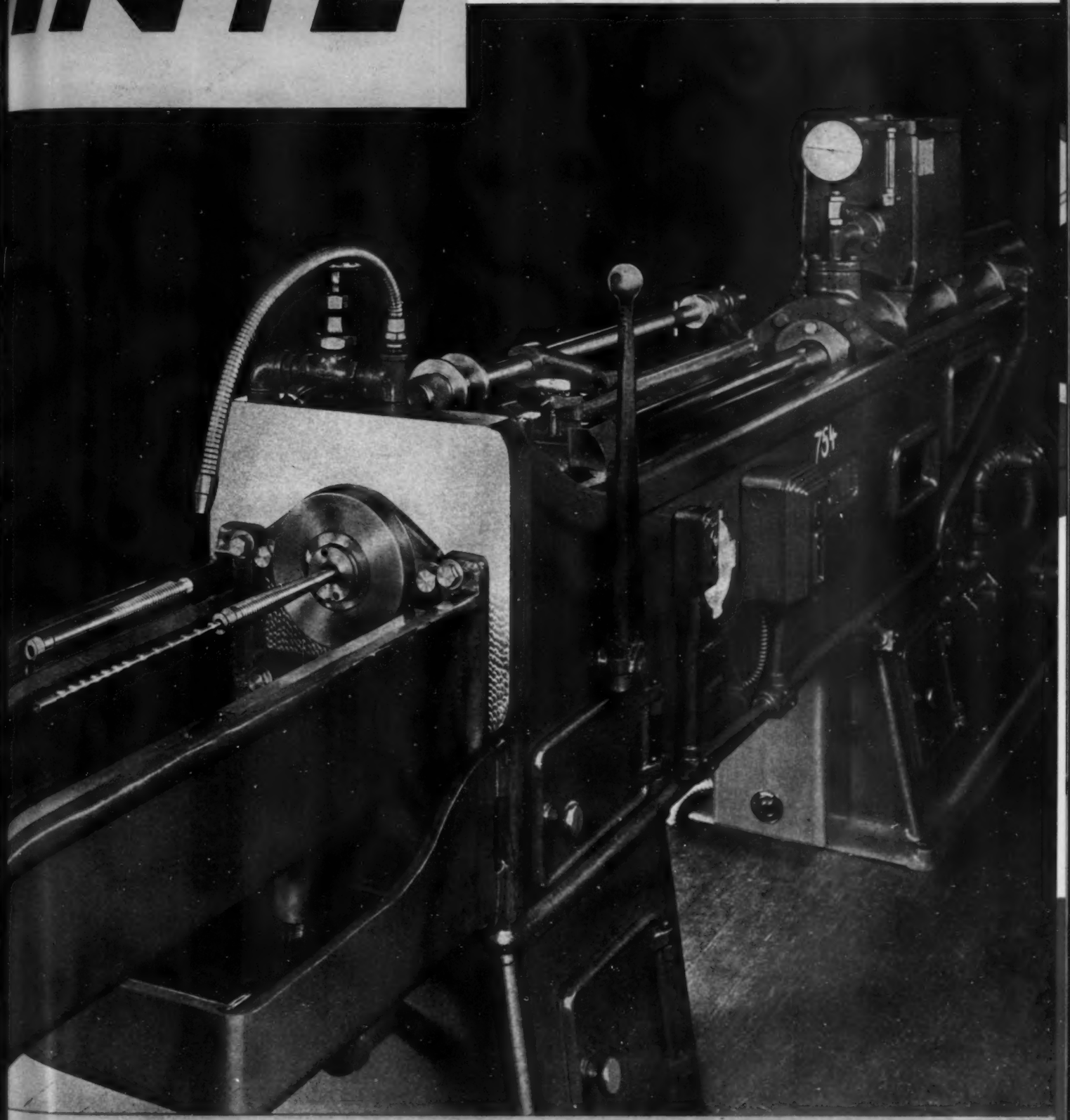
New and unusual jobs are being encountered every day in the National Defense program, and the manufacturer who can meet these problems and produce results — speedily — is the one who will find profits in the exacting task of arms production. Lapointe — Pioneers in the Art of Broaching — are ready to help you work out problems involving the rapid production of accurate flat, curved or irregular surfaces as well as all types of cylindrical work such as gun barrels, gun parts and breech blocks.

Lapointe equipment and Lapointe methods have made broaching a high precision as well as a high production operation. Let us study your new manufacturing problems and show you the opportunities for greater speed, accuracy and economy that Lapointe Broaching Machines and Broaches make possible.



INTE

Below: Lapointe Horizontal Hydraulic Broaching Machine in the plant of the Harrington & Richardson Arms Co., Worcester, Mass., rifling barrels by broaching method for Harrington & Richardson Reising Sub-Machine Guns. These guns, meant for close work, weighing but six pounds and fire 300-500 shots per minute.



LAPOINTE MACHINE TOOL CO.

HUDSON, MASS., U. S. A.

Its nose to the grindstone, this blower system uses

AMERICAN METAL HOSE

In this battery of cutter sharpeners the hazard of a steady stream of sparks and metal particles is removed by a blower system that sends out a suction line of American Flexible Metal Hose to each machine. Handling of hot sparks and sharp, abrasive metal particles is a "run of the mill" job for this particular style of hose. And further advantages lie in its easy adjustability to various positions, its low cost and long life. And how this flexible hose *stays put!*

DESIGNERS of modern machine tools and operators of up-to-date machine shops have learned that it pays to use the RIGHT flexible connections on all of their equipment—whether for the blower system, coolant lines or hydraulic feed. Poor connections mean eventual breakdowns, and breakdowns cost money.

To avoid these costly shutdowns, leading manufacturers of machine tools are equipping their units with strong, durable American Flexible Metal Hose and Tubing—as flexible as garden hose with all the strength you'd expect from its all-metal construction. Would you like to know more about this money-saving flexible metal hose and tubing? Just drop us a note saying, "Send me your literature for the machine tool industry."

•

Hundreds of problems involving flexible metal connectors in the conveyance of steam, air and oil have been solved by the products of American Metal Hose. This book will bring you complete information on American Seamless, the most dependable flexible metal tubing you can buy. 41267

American Metal Hose

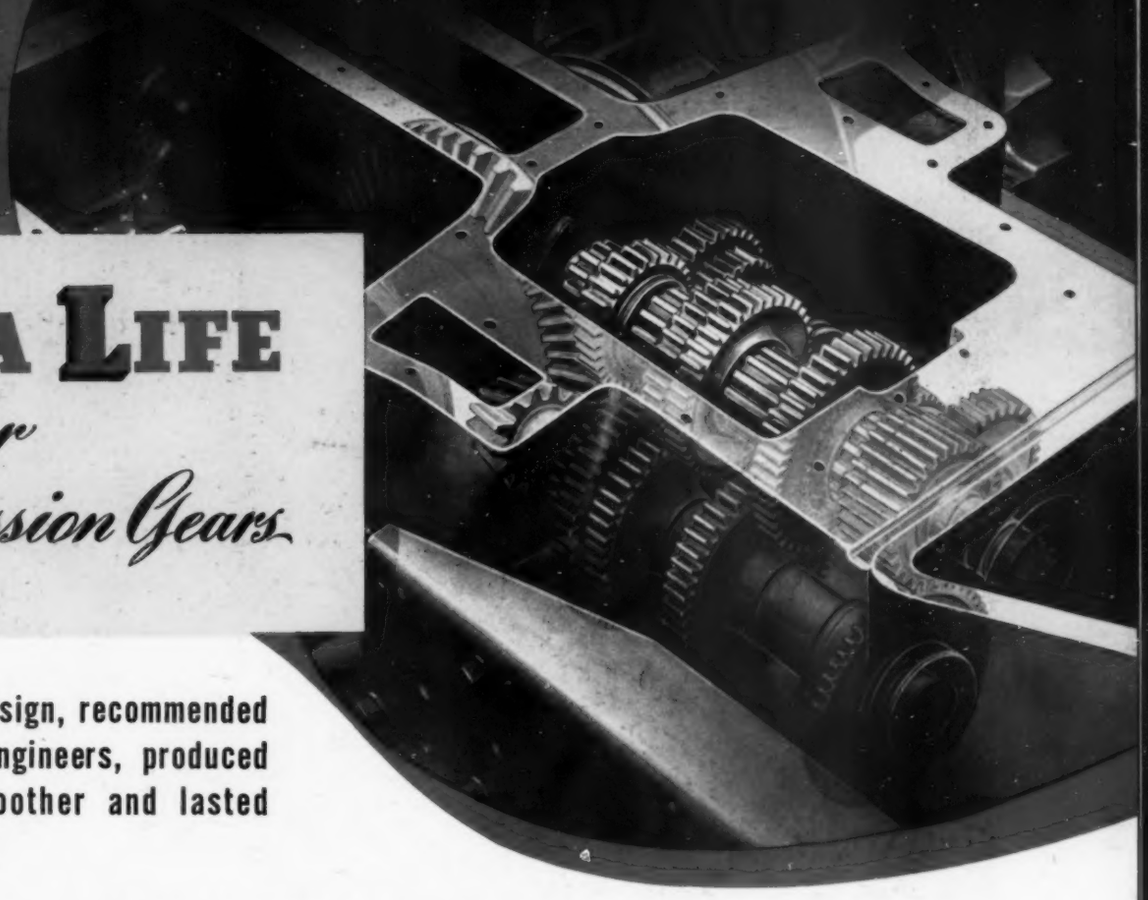
ANACONDA

AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Conn. • Subsidiary of Anaconda Copper Mining Company

In Canada: Anaconda American Brass Ltd., New Toronto, Ontario

HELPING SOLVE INDUSTRY'S PRODUCTION PROBLEMS



EXTRA LIFE *for* *Transmission Gears*

A change in tooth design, recommended by "Illinois Tool" engineers, produced gears that ran smoother and lasted many times longer!

The arbitrary selection of so-called "standard" gear tooth dimensions by rule-of-thumb methods does not always result in a choice of gears best suited for the particular class of work involved. Among the problems that must be thoroughly understood to secure the fullest efficiency from gear drives are:

(1) WHEN and WHY to use 14½° pressure angle

(2) WHEN and WHY to use 20° or any other pressure angle

(3) WHEN and WHY to use spur and helical gears

(4) WHEN and WHY to use "long and short" addenda designs

(5) WHEN and WHY to use "full depth" standard gear teeth and "stub tooth" gear designs

Many manufacturers have learned to rely on "Illinois Tool" engineers for competent advice on such gear design problems. If your gearing problem is of a special nature, you may be able to profit similarly by submitting it to the Illinois Tool Works for analysis and suggestions.

ILLINITE
HIGH SPEED
PRODUCTION TOOLS

Milling Cutters
Ground Hobs
Broaches
Shaper Cutters
Ground Form Tools
Special Tools
Die Filing Machines
Gear Measuring Machines

ILLINOIS TOOL WORKS

MANUFACTURERS OF METAL CUTTING TOOLS AND SHAKEPROOF PRODUCTS

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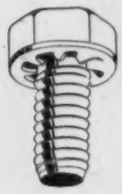
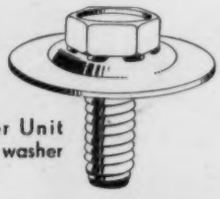
SEMS* FASTENER UNITS

offer many important production advantages and assure greater locking power!

SEMS Fastener Unit with external type lock washer.



SEMS Fastener Unit with internal type lock washer.



SEMS Fastener Unit with dome lock washer —internal teeth.

SEMS Fastener Unit with external-internal type lock washer.

SEMS Fastener Unit with countersunk type lock washer.

● This pre-assembled Shakeproof Lock Washer and Screw Fastener Unit is now being used on hundreds of leading metal products, including automobiles, radios, electrical appliances, etc. It reduces production costs—speeds up assembly operations and improves product performance. Besides its time-saving advantages it definitely produces a stronger fastening because, as indicated at the right, the lock washer fits closer to the screw shank which allows greater tooth contact and, consequently, a more powerful lock between the screw head and the work.

* SEMS is the registered trademark of the Illinois Tool Works, manufacturers of Shakeproof Lock Washers. Only Shakeproof Lock Washers are used in the manufacture of SEMS Fastener Units.

You can't help but save money with SEMS Fastener Units!

Lock Washer and Screw delivered as one unit.

No lost lock washers — an important saving.

No "bottle-neck" delays —speeds up production.

Makes it easier to fasten hard-to-reach parts.

Can be used in hopper-fed automatic drivers.

Inventories balance — one order covers both parts.

SHAKEPROOF LOCK WASHER COMPANY

Distributor of Shakeproof Products
Manufactured by ILLINOIS TOOL WORKS

2501 North Keeler Avenue, Chicago, Illinois

Plants at Chicago and Elgin, Illinois
In Canada: Canada Illinois Tools, Ltd., Toronto, Ontario
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FREE SAMPLES

Test SEMS Fastener Units yourself—write for samples today!

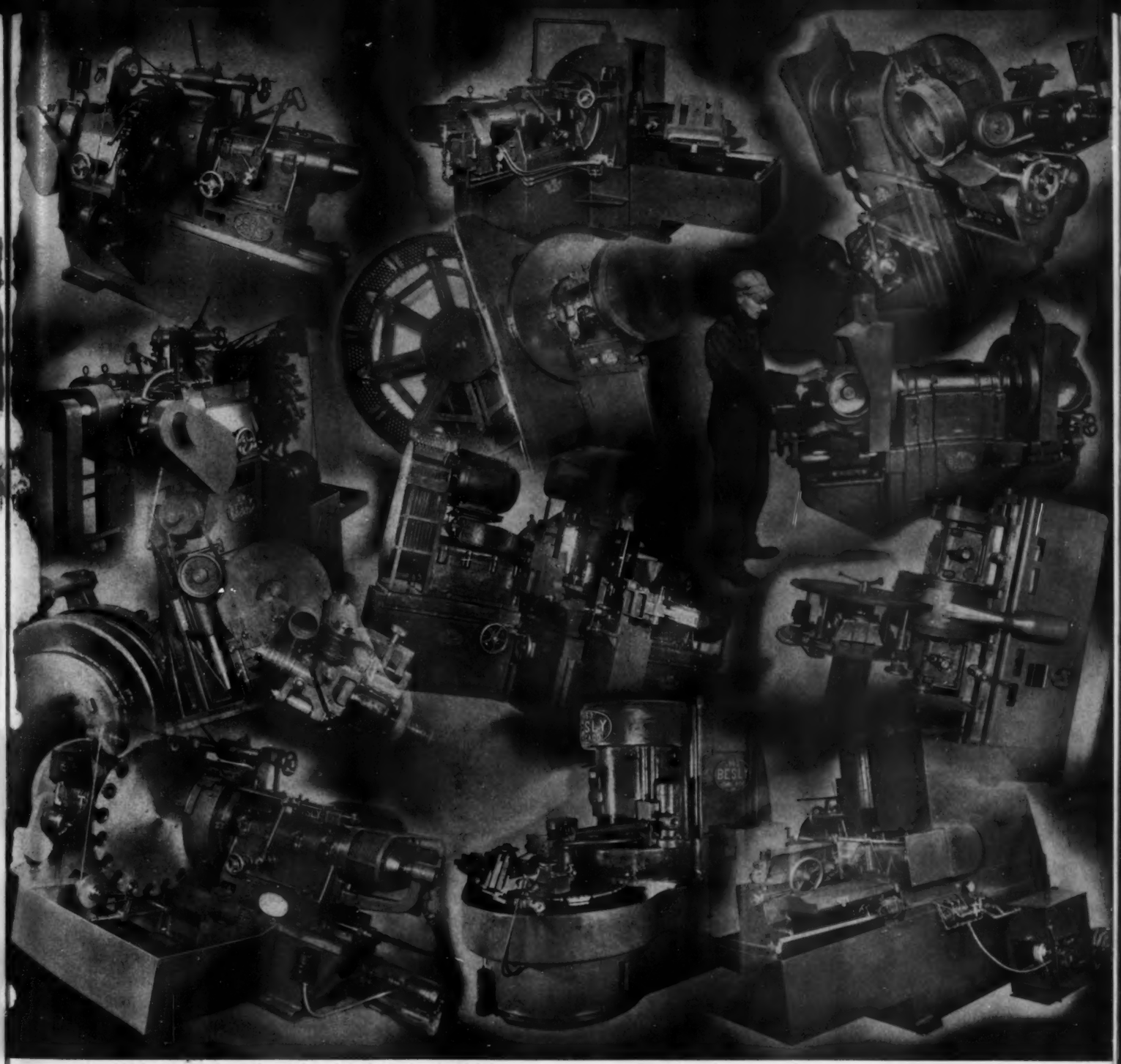
ALL SHAKEPROOF SCREW PRODUCTS AVAILABLE WITH PHILLIPS RECESSED HEADS!

"Fastening Headquarters"

SHAKEPROOF

SEMS Fastener Units . . . Lock Washers . . . Locking and Plain Terminals

Thread-Cutting Screws . . . Locking Screws . . . Spring Washers . . . Special Stampings



Watch the Besly Parade!

MARCHING out of the Besly Engineering Department a veritable parade of Automatic and Semi-Automatic Machines.

Above we show just a few of the many special purpose Besly Grinders that are daily lowering costs—producing more accurate surfaces and improving finish. Let us tell you what the Besly Grinder and the Famous Besly Titan Steelbac Abrasive Wheel can do for you.

CHARLES H. BESLY AND COMPANY

118-124 NORTH CLINTON STREET ★ CHICAGO, ILLINOIS

A BRAND-NEW Defense Handbook

In two colors
(Second color to show parts in process)

128 Pages
8¾ x 11⅝ in.
$1

HOW TO FORGE AND MACHINE ARTILLERY SHELLS

Now, for the first time, all available information on the forging and machining of artillery shell has been combined in one comprehensive, heavily illustrated volume. Included are a complete description of the "pilot" 75-mm. shell and cartridge-case production lines at Frankford Arsenal, a description of the Stewart-Lloyd process for shell forging now in use in Canada, and far-reaching explanations of tooling set-ups for installed and available machining equipment.

Contents of this book were originally published separately as eight special Armament Sections in *American Machinist*. These 128 fact-filled pages include all the material having specifically to do with the forging and machining of shells and the forming of cartridge cases. It is these pages which have been most in demand by industrial executives and Ordnance officers alike. Several of these are sections which are out-of-print again, even after two large reprintings.

The distinctive, clarifying, technique developed for the *American Machinist* Armament Sections is used throughout this book. This unique, illustrative method shows in color the part being machined or otherwise fabricated.

Included in the book is everything the production executive—regardless of title or function—needs to know to handle efficiently the forging and machining of 60-, 75-, 81-, 90-, 105- and 155-mm, and 3.7-in. high-explosive shells, as well as forming technique for 75-mm cartridge cases. It is an essential handbook for anyone now working on, or anticipating, shell orders. The extremely low price of $1.00 has been placed upon the book barely to cover printing, binding, and handling costs. Furthermore, in units of 10 or more copies, price has been set at 80¢ per copy.

128 pages, printed in black and orange, page size 8¾ x 11⅝-in., heavy, serviceable, double-thick cover. Special binding permits all pages to be opened flat. $1.00 per copy delivered, 80¢ per copy for quantities of 10 or more.

AMERICAN MACHINIST
330 W. 42nd St.,
NEW YORK, N. Y.

Please send me, as soon as published ..... copies of "Artillery Shell Manufacture". I enclose check or money order for $..... ($1 per copy in small quantities, $0.80 per copy for orders of 10 or more).

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Address .....

City and State.....

Position .....

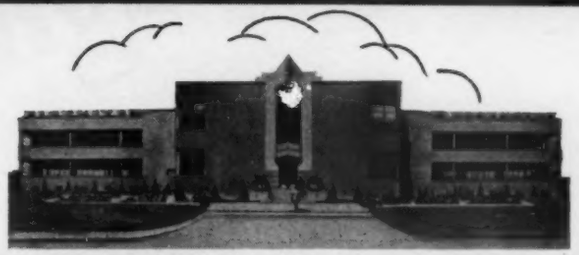
Company .....

(Sold in United States and Canada only)

3 WAYS TO GET FIRTHITE TOOLS

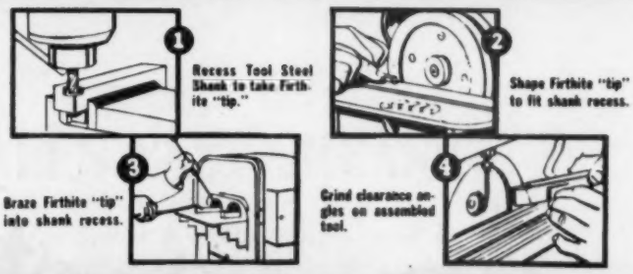
1 Direct From Factory or Branches

From the "home of steel," in the heart of industrial America, FIRTHITE Sintered Carbide Cutting Tools are available from this modern powder metallurgy plant. In 8 other principal cities are branch warehouses, sales offices and engineers, prepared to render localized service.



2 Make Your Own FIRTHITE Tools in 4 Easy Operations

Firth-Sterling offers the *plan,* the *information* and the *materials* for making FIRTHITE Cutting Tools in your own shop. In four basic operations complete carbide tools may be prepared from Firth-Sterling materials. Only standard tool room equipment is required for this work, plus a brazing furnace or torch for brazing.



3 From Your Local Authorized FIRTHITE Tool Maker

In many conveniently located cities local tool makers of established reputation and ability have been authorized by Firth-Sterling to make Carbide Cutting Tools from genuine FIRTHITE materials. Consult your local classified telephone directory, or write for the name of the authorized tool makers nearest to you.

Tools—Tungsten Carbide

Cole Carbide Industries 24645 Ryan Rd. Royal Oak	TO wnsnd-8-7977
Eclipse Counterbore Co. 7410 St. Aubin Ave.	TR inity-2-4581
Falcon Tool Co. 12502 Greiner Ave.	PI ngre-4800
The Gairing Tool Co. 1629 W. Lafayette St.	RA ndlph-7927
Genessee Tool Co. 6432 Cass Fenton	MAdsn-6300
Goddard & Goddard 12280 Burt Rd.	RE dfrd-3000
Gorham Tool Co. 14400 Woodrow Wilson Ave.	TO wnsnd-8-0020
Midwest Tool & Mfg. Co. 2360 W. Jeff.	LA fayet-0055
Morse Tool Co. 116 E. Goldengate Ave.	TO wnsnd-8-2090
Motor Tool Mfg. Co. 12281 Turner St.	HO grth-5300
Production Tool Co. of America 6474 Le Grand Ave.	PL asn-6717
Super Tool Co. 21650 Hoover Rd.	AR lngtn-1500
Wesson Company 1050 Mt. Elliott Ave.	FI tary-1400

Information about any of these optional sources, that assure you of the advantage of genuine FIRTHITE Sintered Carbide Cutting Tools, will be gladly furnished upon request.

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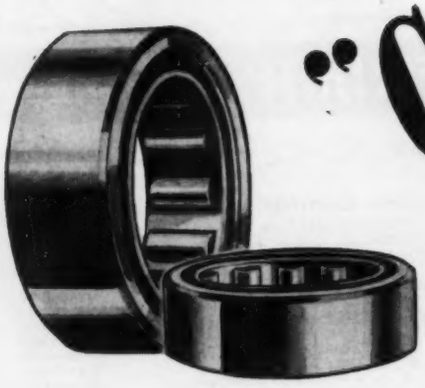

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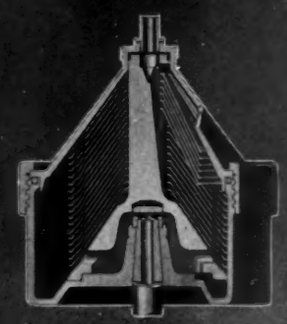

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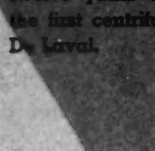

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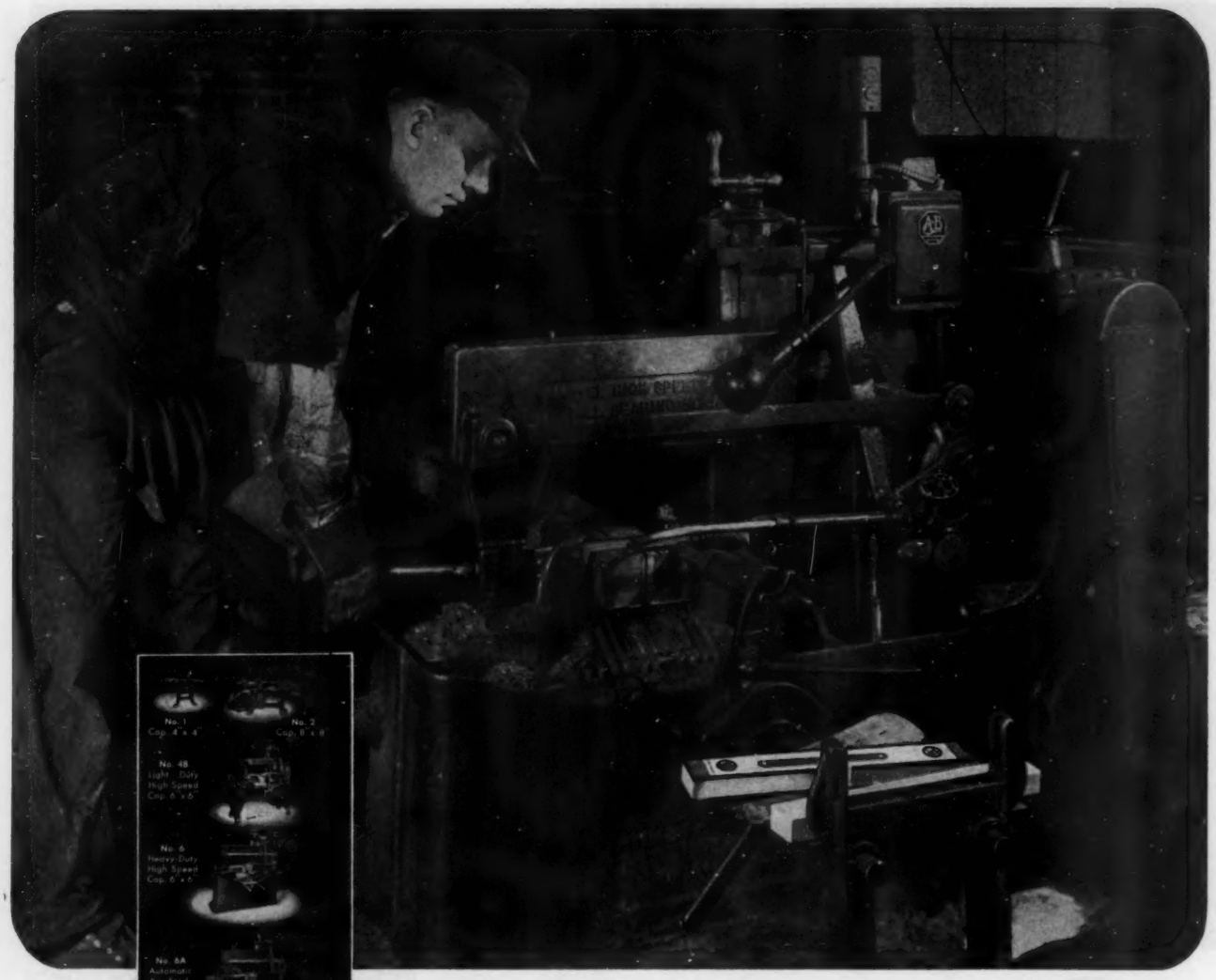

"24 hours a day, 7 days a week for the past 3 years"

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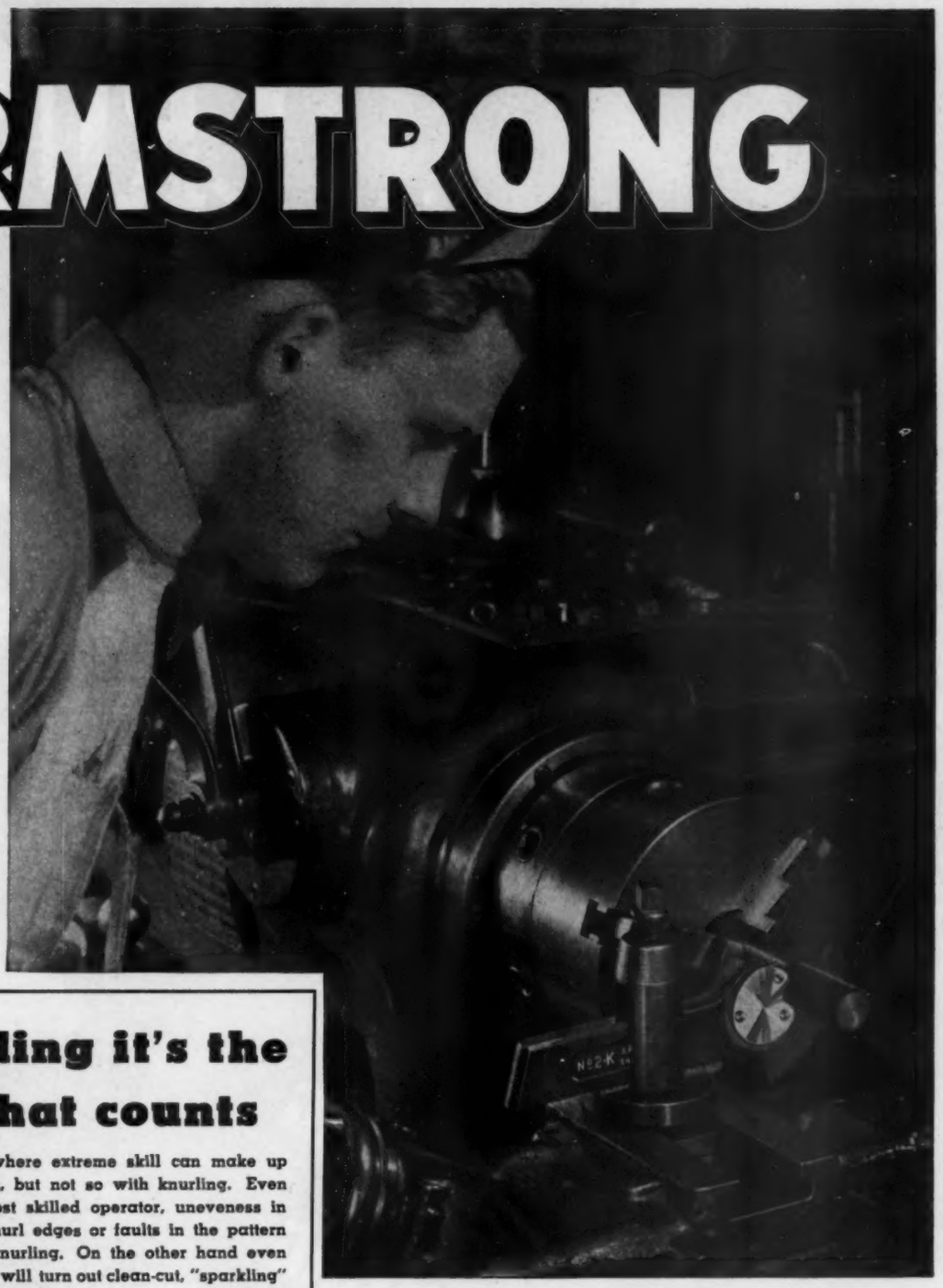

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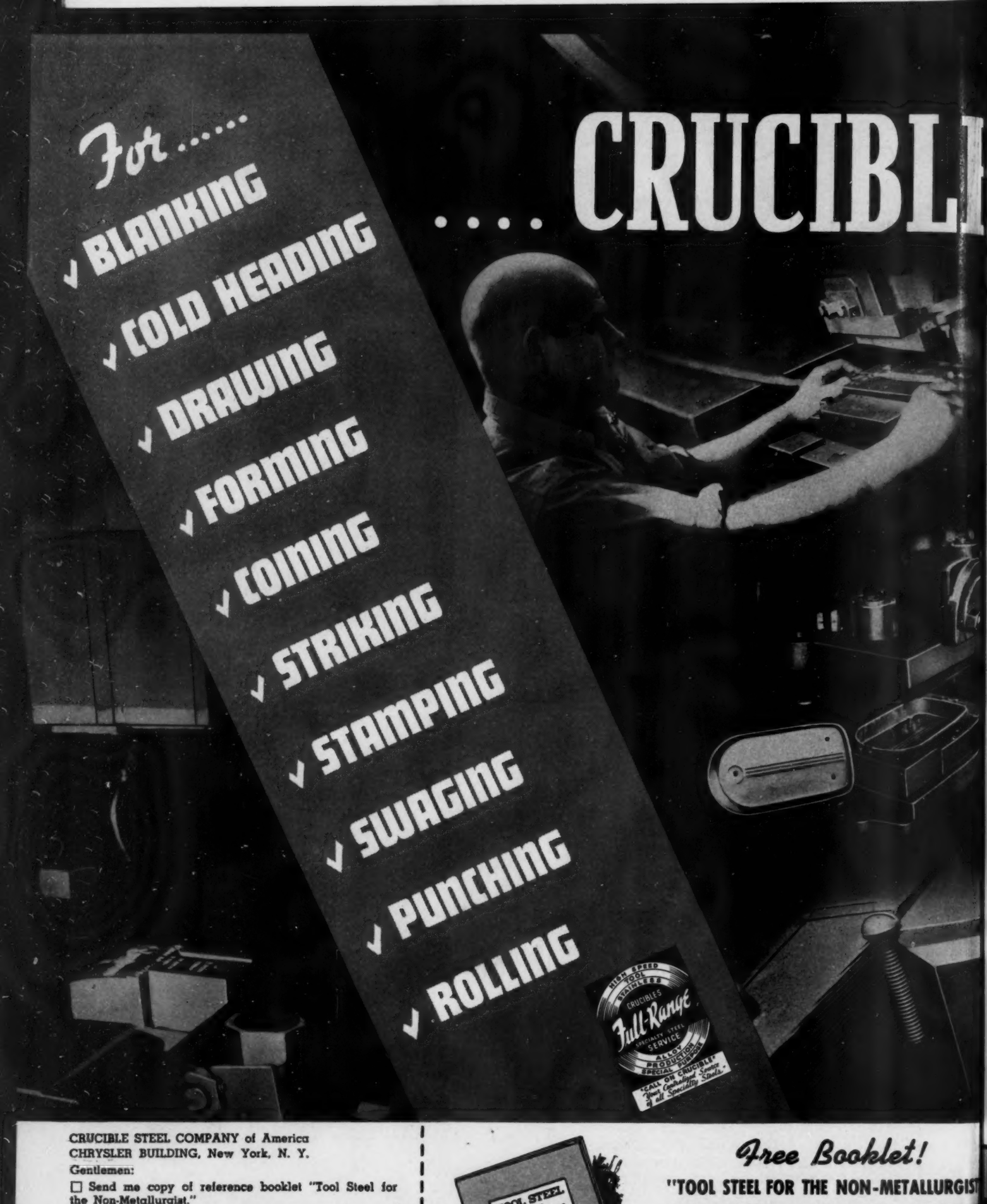

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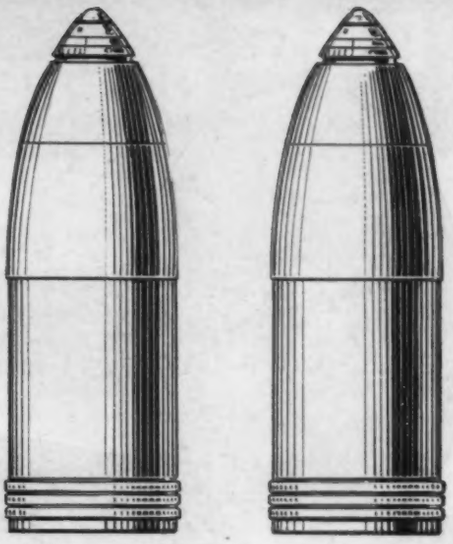

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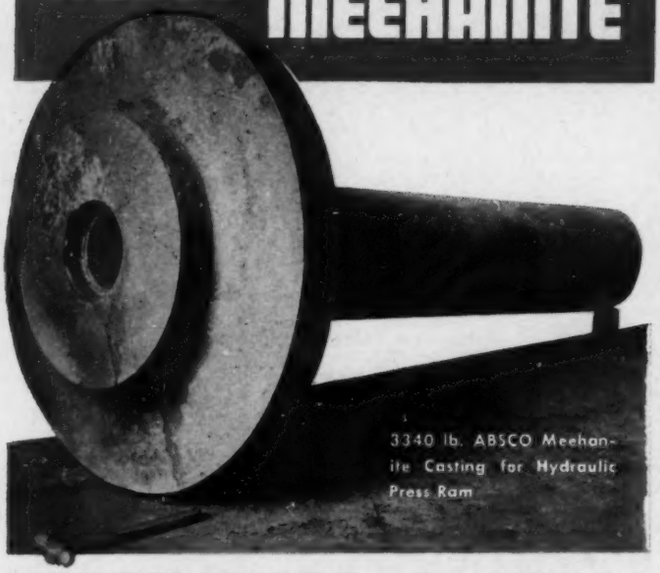

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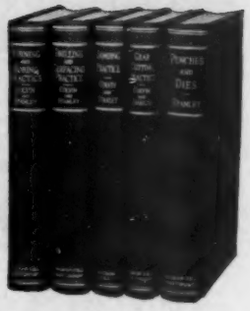

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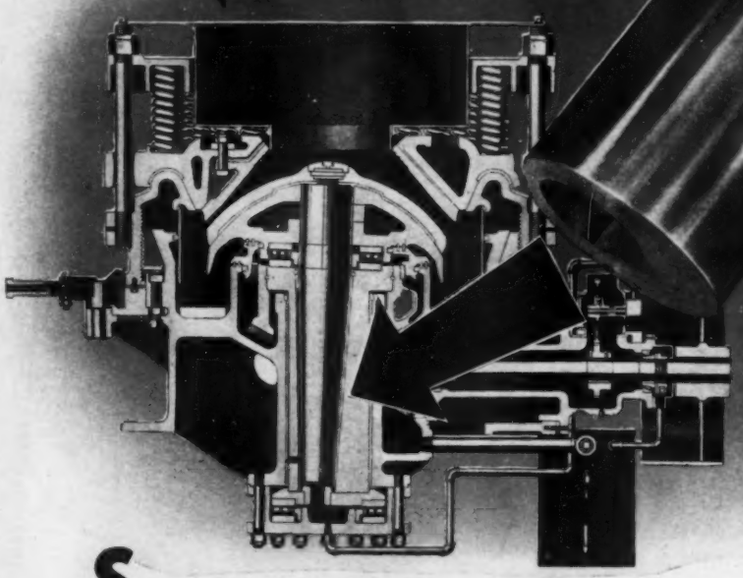

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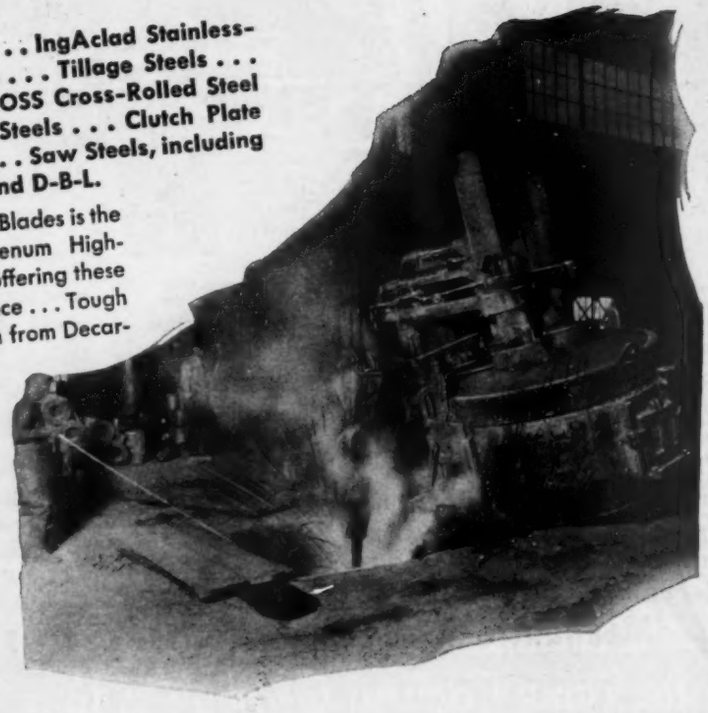

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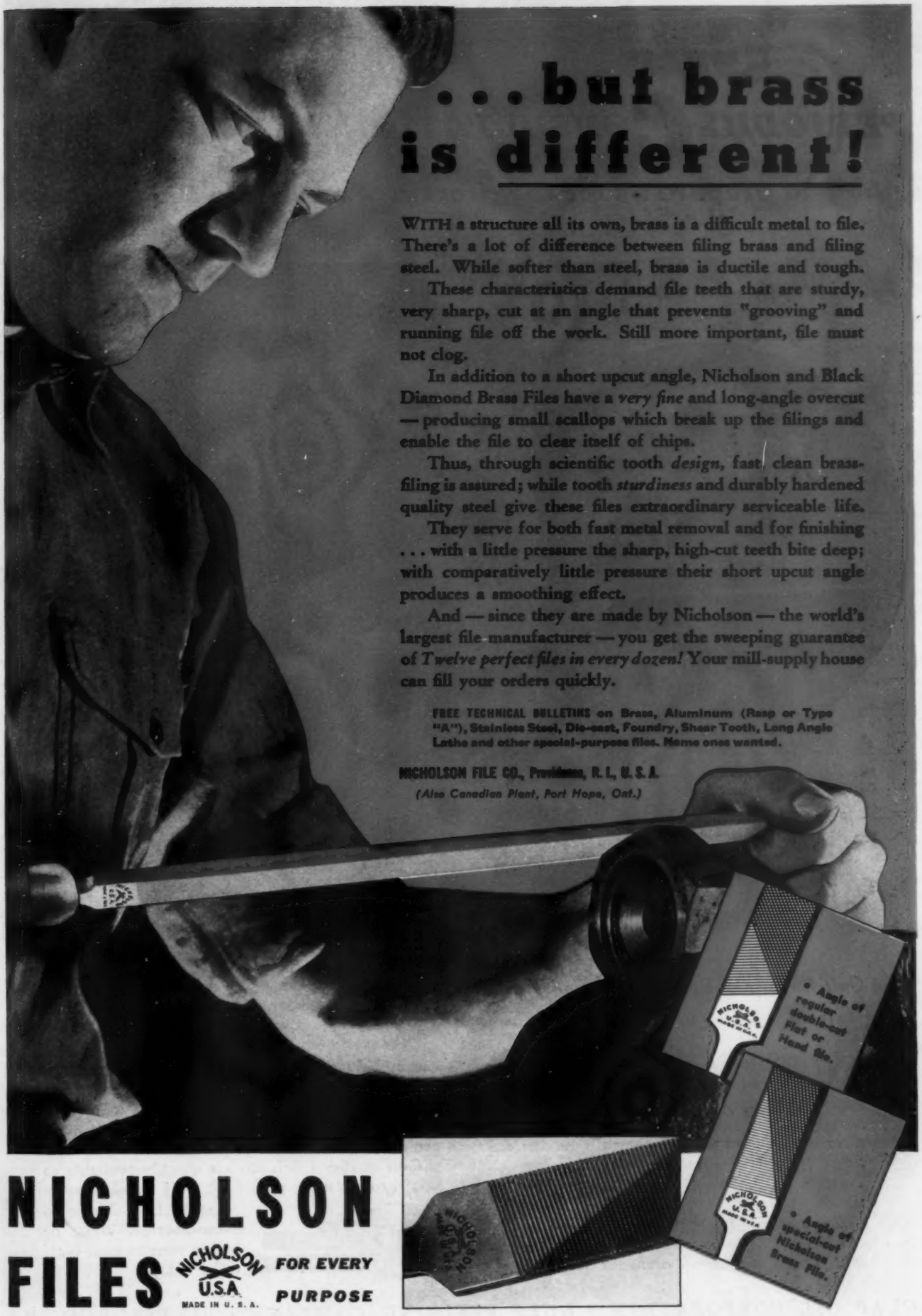
Plants: New Castle, Ind., Chicago, Ill., Kalamazoo, Mich.

INGERSOLL STEELS

"PRODUCTS OF BORG-WARNER CORPORATION"


. . . but brass is different!
WITH a structure all its own, brass is a difficult metal to file. There's a lot of difference between filing brass and filing steel. While softer than steel, brass is ductile and tough.
These characteristics demand file teeth that are sturdy, very sharp, cut at an angle that prevents "grooving" and running file off the work. Still more important, file must not clog.
In addition to a short upcut angle, Nicholson and Black Diamond Brass Files have a *very fine* and long-angle overcut — producing small scallops which break up the filings and enable the file to clear itself of chips.
Thus, through scientific tooth *design*, fast, clean brass-filing is assured; while tooth *sturdiness* and durably hardened quality steel give these files extraordinary serviceable life.
They serve for both fast metal removal and for finishing . . . with a little pressure the sharp, high-cut teeth bite deep; with comparatively little pressure their short upcut angle produces a smoothing effect.
And — since they are made by Nicholson — the world's largest file manufacturer — you get the sweeping guarantee of *Twelve perfect files in every dozen!* Your mill-supply house can fill your orders quickly.
FREE TECHNICAL BULLETINS on Brass, Aluminum (Rasp or Type "A"), Stainless Steel, Die-cast, Foundry, Shear Tooth, Long Angle Lathe and other special-purpose files. Name ones wanted.
NICHOLSON FILE CO., Providence, R. I., U. S. A.
(Also Canadian Plant, Port Hope, Ont.)
• Angle of regular double-cut Flat or Hand file.
• Angle of special-cut Nicholson Brass File.
NICHOLSON FILES
NICHOLSON U.S.A. MADE IN U. S. A.
FOR EVERY PURPOSE

"GULF PERIODIC CONSULTATION SERVICE

helped prepare us for the present 'Production Emergency'"

. . . Says Superintendent in this aircraft plant.

(Above) Actual photograph of a Gulf engineer on a Periodic Consultation Service call—discussing lubrication with the superintendent of the machinery division.

"The Gulf Engineer's Recommendations have been a big help in speeding up defense output in our plant"

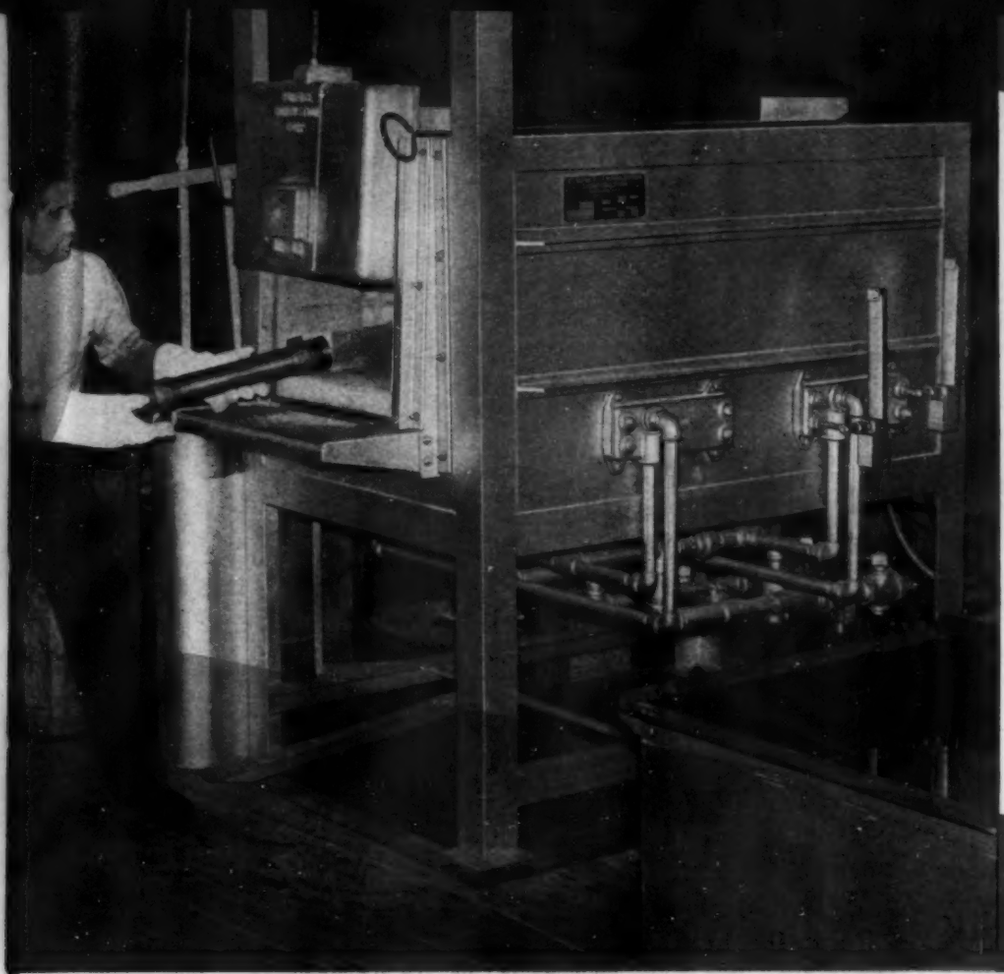
"WHEN defense orders started pouring in our plant a few months ago, we called in a Gulf engineer. By following his recommendations, we have been able to speed up some of our key equipment to provide for the present production emergency," says this superintendent. "We credit Gulf Periodic Consultation Service with some very timely assistance."

Are you getting maximum output from your equipment? Ask a Gulf engineer to look it over and give you his recommendations for its proper lubrication. You will be under no obligation, and you can benefit from his broad experience in many metal working plants. His one big aim today is to help you speed defense production through modern efficient lubrication practice.

Gulf quality lubricants are quickly available to you through more than 1200 Gulf warehouses in 30 states from Maine to New Mexico. Write or phone your nearest Gulf office today.

GULF INDUSTRIAL LUBRICATION

GULF OIL CORPORATION · GULF REFINING COMPANY · PITTSBURGH, PA.



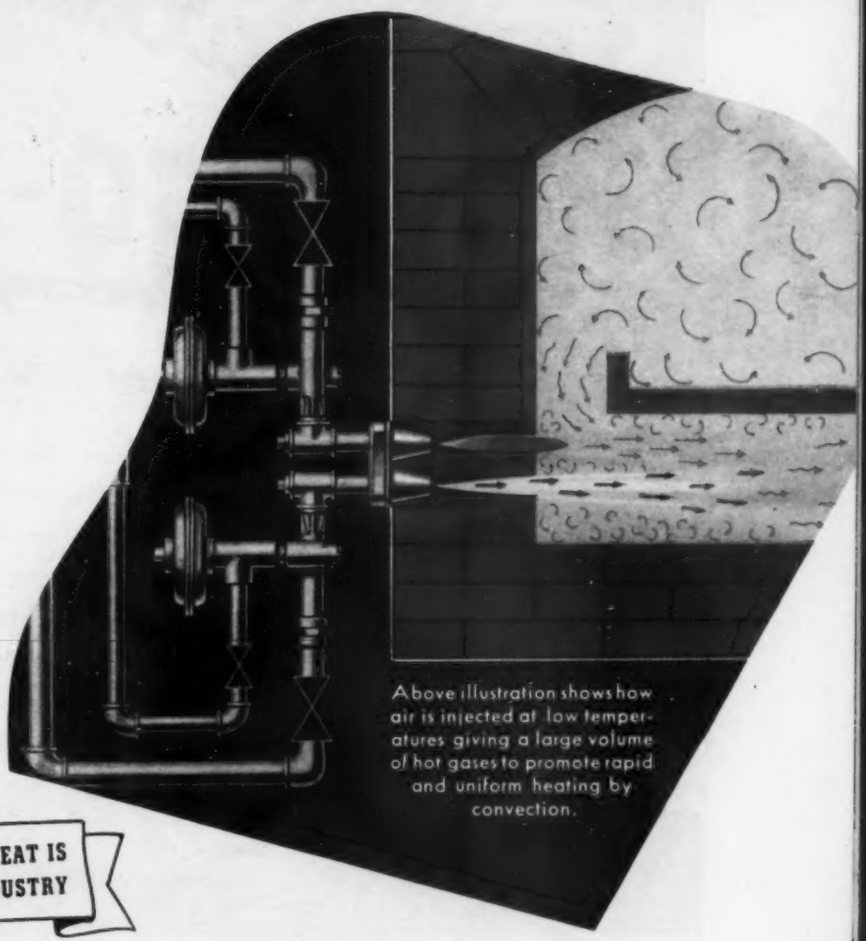
TWO FURNACES *IN ONE*

Conjecto-Fired Burners Make Possible High and Low Temperature Furnace

The newly developed SC burner system of Conjecto-Firing—employing unique twin nozzle burners—has made possible the construction of SC Standard Rated Small Oven Furnaces with a wider temperature range and closer temperature control than ever before. At low temperatures, air is automatically injected through one of the twin nozzles to give a large volume of hot gases for uniform and rapid heating—the same principle used in low temperature circulated air or convection heating furnaces.

At higher temperature operations, such as annealing, hardening and normalizing, both nozzles function in the usual manner burning a correctly proportioned gas-air mixture. However, as the temperature of the furnace approaches the desired operating temperature, one set of nozzles is automatically shut off, thus reducing the possibility of over-shooting the desired temperature.

SURFACE COMBUSTION CORPORATION · TOLEDO, OHIO



Above illustration shows how air is injected at low temperatures giving a large volume of hot gases to promote rapid and uniform heating by convection.

Write for copy of bulletin SC-90A which describes the new system of Conjecto-Firing in detail.

WHEREVER HEAT IS USED IN INDUSTRY

SURFACE COMBUSTION

MANUFACTURERS OF INDUSTRIAL FURNACES · JANITROL GAS-FIRED SPACE HEATING EQUIPMENT · AND KATHABAR AIR CONDITIONING SYSTEMS

to meet the nation's need

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TRADE MARK REG. U.S. PAT. OFF.

MOLYBDENUM-TUNGSTEN HIGH SPEED STEEL

Metal-cutting tools of all kinds made of MO-MAX, the molybdenum steel with an eight-year record, average twenty per cent higher in efficiency than corresponding tools made of 18:4:1; require eight per cent less weight of steel; hold their cutting edges for more cuts between grinds. For production, for economy, for universal application, rely on MO-MAX.

Please consult your usual sources of supply. Leading steel companies are licensed to produce their own brands of MO-MAX under patents owned by The Cleveland Twist Drill Co.

998

TODAY...

more than ever,

the BEST cutting oil you can buy

is the ONLY good one!

Today, under the intensive drive of the Defense Program, is certainly no time to try unproven "just-as-goods." Correctly chosen cutting oils are an aid to precision machining which may well mean the difference between "OK" and "Reject." Men who know the Houghton record—dating back half a century—realize that when they specify a recommended Houghton coolant, it can make their machining job much easier, much safer.

Houghton straight cutting oils and bases will provide the finer finish, the longer tool life, and permit the faster speeds so imperative today. That's why it was "Houghton, 2 to 1," in two recent impartial surveys made of the metal-working trade asking what cutting oils were preferred. To beat a new tough job or improve an old one, why not call in the Houghton Man? Write or phone E. F. HOUGHTON & CO., Philadelphia and all principal cities.

The HOUGHTON LINE
of straight Cutting Oils and Bases

GET MAXIMUM PRODUCTION *from Your Machines by having* WELCO *provide* "POWER WHERE YOU WANT IT"

TORQUE WELCO MOTORS

Investigate TODAY!

Welco engineers are available to discuss the advantages of "Power Where You Want It" on your equipment. Outline your problem and ask us to help you solve it.

By installing WELCO TORQUE MOTORS on your production machines for handling slow, time consuming motions, you can step-up speed, efficiency and capacity in accordance with present day needs.

These motors will not only modernize equipment for greater productivity and easier control, but save money through elimination of complicated motions which entail high maintenance costs.

Such motions as are involved in clamping and unclamping, raising and lowering, traversing, indexing, are speeded up and simplified by modern Welco Motors which can be mounted in any position, provide maximum power at start, and which can be stalled safely or quickly reversed.

Welco Torque Motors are available in AC and DC types and are provided with mountings for practically any application. Flexibility of adaptation and simplicity of providing "Power where you want it," recommend WELCO motors for increasing the production capacity of existing machines and machine tools.

The B. A. WESCHE ELECTRIC CO., 1626 Vine St., Cincinnati, Ohio

UNAMATIC PROCESS

DUAL HEAD MOUNTING *Eliminates Residual Stresses*

● At Steelweld Division, of The Cleveland Crane and Engineering Co., two Una protected arc automatic welding heads are used in welding 3", 4", and 5" bed plates to the bases. The company reports that the simultaneous welding of both sides effects 50% saving in labor as against welding first one side and then the other, and that the even controlled heat eliminates residual stresses.

Investigate the advantages of Una protected arc automatic welding for any repetitive welding operation. It's 3 to 4 times faster than manual welding—produces a better product—at lower cost—and operators need only a few weeks' training. Suggestions and estimates of cost furnished on request, without obligation. Write to:—

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1612 Collamer Road • Cleveland, Ohio
Engineering Representatives in the Principal Cities

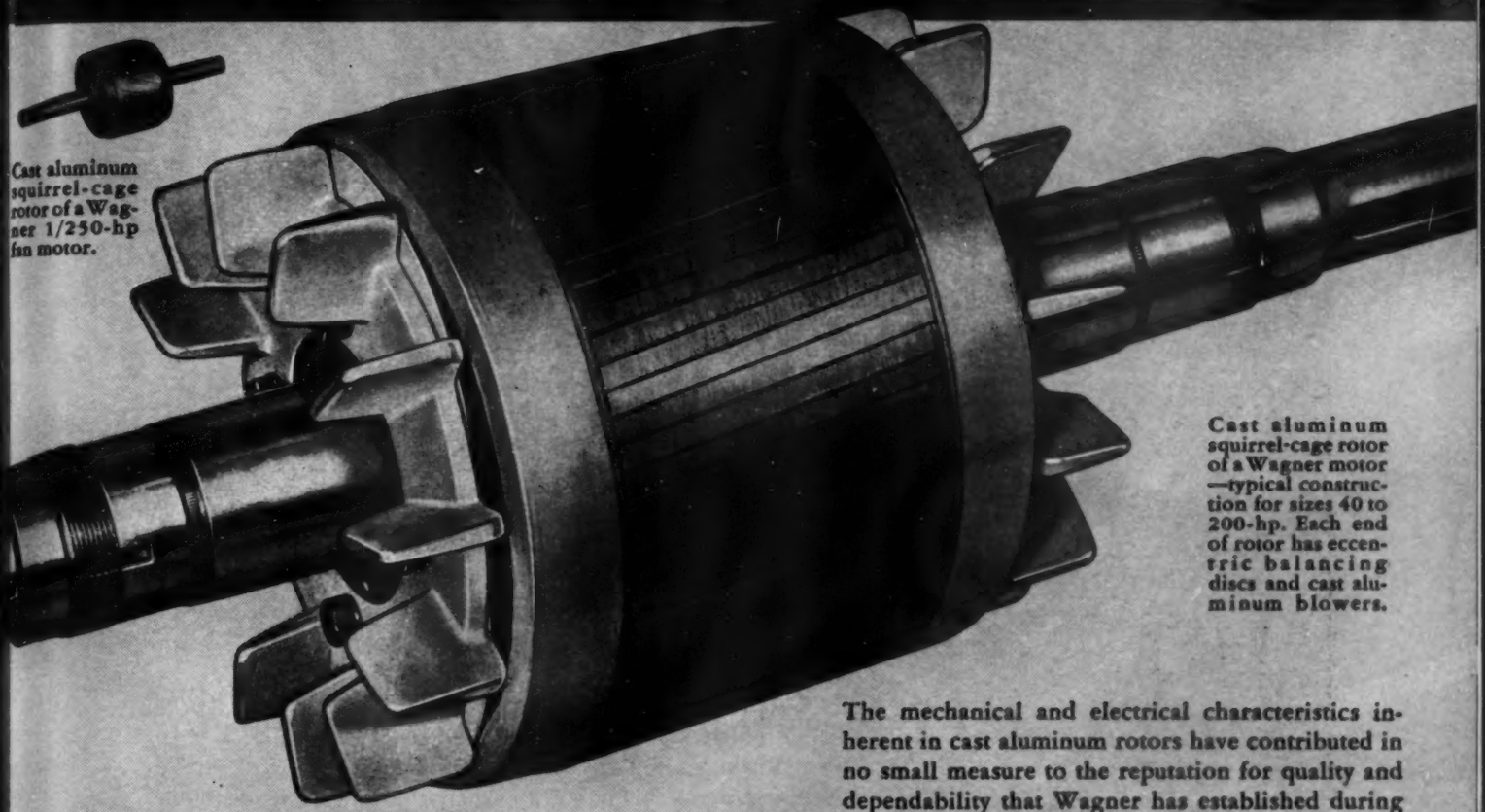
FOR MILD, MEDIUM, HIGH CARBON AND STAINLESS STEELS, ALLOYS AND NON-FERROUS METALS

UNAMATIC PROTECTED ARC WELDING

BETTER — AND FROM 3 TO 4 TIMES FASTER THAN MANUAL WELDING

Hundreds of Thousands of WAGNER MOTORS with Cast Aluminum Rotors

have been built during the past *20 Years* and are still giving *perfect satisfaction!*



Cast aluminum squirrel-cage rotor of a Wagner 1/250-hp fan motor.

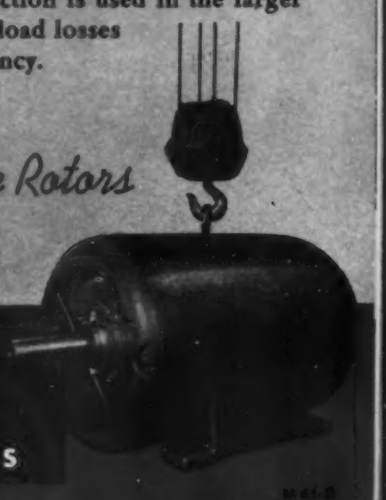
Cast aluminum squirrel-cage rotor of a Wagner motor—typical construction for sizes 40 to 200-hp. Each end of rotor has eccentric balancing discs and cast aluminum blowers.

The mechanical and electrical characteristics inherent in cast aluminum rotors have contributed in no small measure to the reputation for quality and dependability that Wagner has established during the past 50 years.

Some of the advantages of cast aluminum construction are:

1. The squirrel-cage is cast under heavy pressure, completely filling the closed rotor slots and the moulds which form the end-rings.
2. The rotor bars and end-rings make complete and intimate contact with the core iron, facilitating heat transfer and absolutely eliminating squirrel-cage vibration.
3. The squirrel-cage material in general-purpose motors is practically pure aluminum of high conductivity and ductility. The most severe service does not make it brittle.
4. A special patented construction is used in the larger sizes, resulting in reduced load losses and increased motor efficiency.

Wagner Uses Cast Aluminum Squirrel-Cage Rotors From 8-Inch Fans to 200-hp Motors



Wagner Electric Corporation

6400 Plymouth Avenue, Saint Louis, Mo., U.S.A.

MOTORS • TRANSFORMERS • FANS • BRAKES

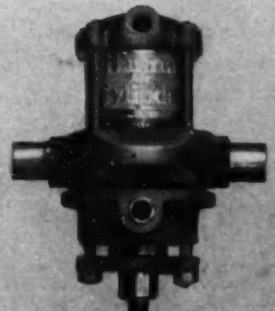
LOOK into your PLANT

There are probably many jobs that could be handled FASTER . . . BETTER . . . and at LESS COST with

Hanna Cylinders

MODEL 4

MODEL 14



MODEL 17

TODAY'S production schedules demand the greatest possible efficiency from both men and machines. Check over operations in your plant — perhaps much of the work that's now being done slowly by sheer physical effort or obsolete methods could be performed more quickly, safely and economically by a Hanna Cylinder.

For example, the practicability of Hanna Cylinders has been demonstrated in improving the operation of equipment such as presses — shears — clutches — valves — brakes — strip reel pushers — hopper gates — furnace and oven doors — material handling equipment — assembly fixtures — furniture clamps — damper regulation — hoists — any place where a push or pull is needed, either directly or through levers or toggles.

Hanna Cylinders are built in a wide range of sizes, for pneumatic or hydraulic operation. Write for complete details.

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Air and Hydraulic RIVETERS | **Air HOISTS** | **Air and Hydraulic CYLINDERS**

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EXECUTIVE OFFICES: JAMESTOWN, N. Y. FACTORIES: JAMESTOWN, N. Y., PLAINVILLE, CONN.

"Toughest Job in the Plant" Made Easy with CURTIS Hydraulic Lifts!

Five years ago the Long Island City plant of the National Sugar Refining Company installed two Curtis Hydraulic Lifting Cylinders operating two platform lifts. Since that time they have operated almost continuously, 8 hours a day, 5 days a week for 5 years—and maintenance costs have been practically negligible.

It used to be a back-breaking task to manually load 55-lb. cartons of sugar on a skid as they come off a conveyor..Now, by placing the skid on a lift and lowering the lift as the pile of cartons builds up, manual lifting is eliminated. When the skid is fully loaded, the lift is raised and the skid taken off by an automatic lift truck. Men can now work at this job on 4 hour shifts *without fatigue*, and the job is no longer the "toughest duty in the plant."

If your factory has a problem in material handling—feeding machines, loading or unloading trucks, moving material to different levels, you too can perform this work better, faster, and at lower cost with Curtis Hydraulic Lifting Cylinders.

Curtis Hydraulic Lifting Cylinders Offer You:

- Low first cost
- Instant, accurate control
- Inexpensive operation and maintenance
- Capacity up to 17 tons
- Easy installation
- Actuated by shop air lines or electricity
- Safety oil locked at all heights

Manufacturers throughout the country are cutting costs and improving production with Curtis Hydraulic Lifting Cylinders. It will pay you to investigate the wide range of uses for this equipment. Send the coupon below for detailed bulletin and free booklet on "How Air Is Being Used in Your Industry."

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1924 Kienlen Avenue, St. Louis, Mo.

Please send me booklet "How Air Is Being Used in Your Industry."

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Firm.....

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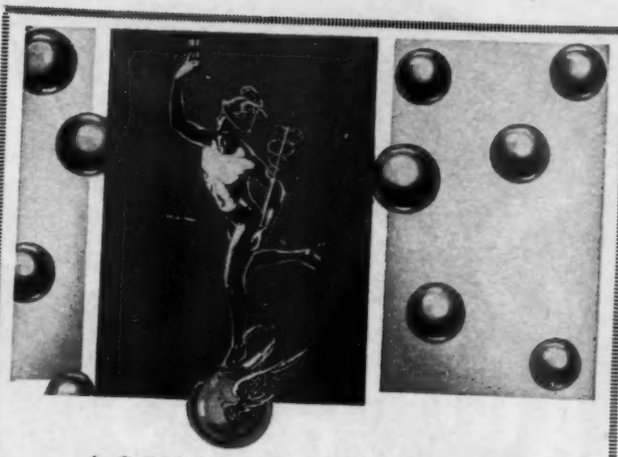
City.....State.....



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All WATERBURY STEEL BALLS are of uniform hardness which extends to the center of each ball. Made of high carbon chrome alloy steel highly finished.

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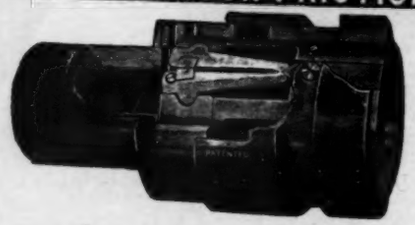
HIGH CARBON, CHROME ALLOY STEEL, BRONZE, MONEL METAL, STAINLESS STEEL BALLS, STANDARD OR SPECIAL SIZES. WRITE FOR COMPLETE INFORMATION.

THE WATERBURY STEEL BALL CO., INC.
Poughkeepsie, New York
Factory: Waterbury, Conn.

THE JOHNSON FRICTION CLUTCH



Single Clutch showing working parts.

. . . for better clutch performance under ANY CONDITIONS

More than thirty years of successful application of JOHNSON FRICTION CLUTCHES to practically all power transmission demands is behind every recommendation made by our Engineering Department.

You can, therefore, depend on better clutch performance regardless of the severity of operating conditions, when you bring your clutch problems to JOHNSON Engineers for study.

Among the operating features which contribute to better performance are sensitive starting, safety, cleanliness, quietness, efficiency and long life.

You incur no obligation in asking us to show specifically how you can improve power transmission on your machines. Just give us the details of your problem.

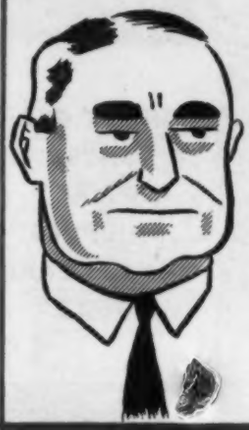
Double Clutch between bevel gearing.

Write for 1940 Blue Clutch Catalog No. 33, covering expanding ring clutches and our literature covering the "MAXITORQ" floating plate disc type.

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER, CONN.

I was worried

when I realized our production was not geared to meet delivery dates. New business had come our way, spurred by national defense. Were *we* going to lag behind?



But determined

I studied every operation . . . consulted time-and-motion experts . . . went through the plant for the hundredth time, and *there* on the assembly line... was a major cause of delay.

Slow work?

"Yes," said one foreman, "our screw-driving *is* slow. Can't use power drivers, for fear of driver slippage. Hand driving is hard work . . . screws go in crooked . . . screw heads split."

THE CAUSE . . .

"Old-Fashioned Fastening"

I began to notice. Screws fumbled. Driver wobbling. Help needed to steady the parts. Everywhere — waste resulted because I had insisted, *incorrectly*, that slow-driving screws *cost less!* I decided —

Don't Be Old-Fashioned

Phillips Screws Will End Slow, Wasteful Fastening

It's just good sense, I found out. The driver can't slip from the Phillips recess — so pneumatic or electric drivers can be used. No more screw driver accidents — no more delays — no more unnecessary worker fatigue. No wonder so many industries are standardizing on Phillips Screws.

Don't forget—it isn't the *price* of the screws that counts. It's the cost of *using* them. Thousands agree — *Phillips Screws cost less to use!*

PHILLIPS RECESSED HEAD SCREWS...

WOOD SCREWS • MACHINE SCREWS • SHEET METAL SCREWS • STOVE BOLTS
SPECIAL THREAD-CUTTING SCREWS • SCREWS WITH LOCK WASHERS

U. S. Patents on Product and Methods Nos. 2,046,343; 2,046,837; 2,046,839; 2,046,840; 2,082,085; 2,084,078; 2,084,079; 2,090,338. Other Domestic and Foreign Patents Allowed and Pending.

Speed Product Deliveries by Cutting Assembly Time

American Screw Co., Providence, R.I.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N.H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N.Y.
Pawtucket Screw Co., Pawtucket, R.I.
Pheoll Manufacturing Co., Chicago, Ill.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N.Y.
Scovill Manufacturing Co., Waterbury, Conn.
Shakeproof Lock Washer Co., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
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Philadelphia GEARS
All types and sizes of industrial gears. Can be supplied in all materials.

And that's only one of the many reasons why such a large part of American Industry calls Philadelphia . . . **"Gear Headquarters".**

- Our long experience in making gears of all types and materials—nearly 50 years—can provide the right answer to practically every gear problem.
- Our extensive gear making equipment can turn out the exact gears you need.
- Our men are skilled in making quality products to meet the most exacting requirements.

For all your gear problems . . . the best answer is **"Get in touch with Phillie Gear"** . . . Want a copy of our Gear Catalog?

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Must you meet stiffer production schedules? Cincinnati can provide the gears you need . . . gears that maintain predetermined precision on 1 or 1000, resulting in extra profit.

High speed, uncanny precision . . . you'll find Cincinnati gears better in many ways . . . and The Cincinnati Gear Company is still meeting delivery promises with amazing success.

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Quality Gears Cut to Order

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All types—to your specifications

With our modern facilities we can produce all types of gears in any material, quantity or size—*promptly—economically.*

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BRAUN GEAR CO.
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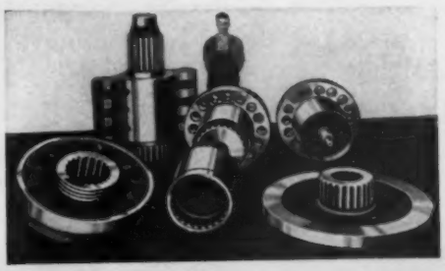
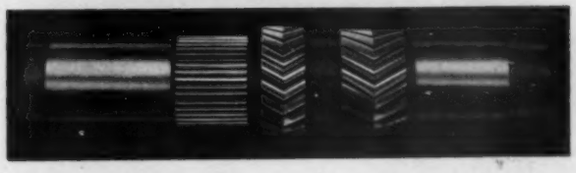




UNUSUAL *and* DIFFICULT GEAR JOBS CUT QUICKLY *and* ECONOMICALLY *on*

FARREL-SYKES GEAR GENERATORS

The photographs above are two examples of the many different classes of gear cutting work produced on Farrel-Sykes Gear Generators and illustrate the unique facilities of our gear plant.

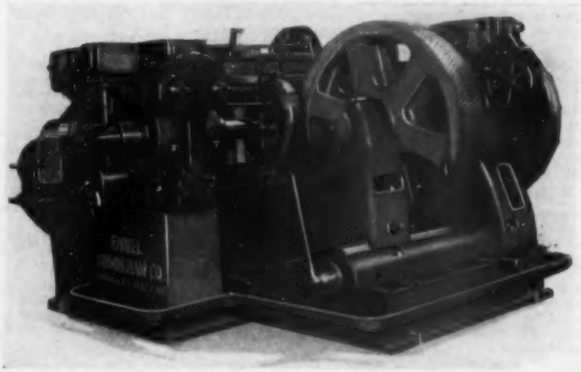
The splined parts for operating Boulder Dam butterfly valves require unusual equipment because of the large difference between the outside and spline diameters. Both internal and external splines are generated with short involute teeth, a very economical way of producing large splined shafts.

The gear component consists of a shaft having integral with it two herringbone pinions and one spur pinion.

We have twenty-five Farrel–Sykes Gear Generating Machines installed in our Buffalo plant to produce gears of a wide variety of types and sizes. For those who wish to produce their own gears we offer the machines with which to do so.

Farrel-Sykes Gear Generators are the most universal of gear generating machines and offer many advantages to the gear manufacturer seeking diversity of output, speed of production, economy of operation and accuracy of product.

Full information will be sent on request



This size 5-B Farrel-Sykes Gear Generator has a capacity from 1″ to 61″ diameter; 12 DP to 2 DP helical and 1½ DP straight teeth; 0 to 18″ face double helical; 0 to 10″ face single helical or straight teeth. Six other standard sizes provide a range of capacities from 0 to 264″ diameter, 0 to 60″ face; 24 DP to 0.5 DP.

FARREL-BIRMINGHAM COMPANY, INC.
355 Vulcan St., Buffalo, N. Y.

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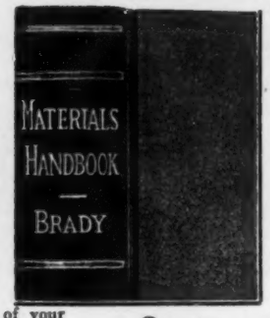
Represents three things to gear users—quality, speed, economy.

GRANT GEARS have a world-wide reputation. Accuracy, durability and dependability gained by experience of over sixty years.

GRANT GEAR WORKS BOSTON

Practical data at your fingertips . . .

MATERIALS HANDBOOK



By George S. Brady, formerly Technical Adviser to the U. S. Coordinator for Industrial Purchasing. 591 pages, 6x9, $5.00.

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Gives the facts you want—about materials of your business—common or unusual—to enable you to face the task of estimating, specifying, and purchasing, more easily, more intelligently, more economically. More than 5000 materials are covered—metals, woods, industrial fabrics, chemicals used in industry, useful minerals, ceramics, paints, resins, etc. Each material is covered with regard to relative quality, composition, strength, weight,—whatever facts are necessary to give a quick, practical, and authoritative picture of the place of the material in industry. A desk tool of constant usefulness to all who deal with, specify, or purchase materials.

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bearing metals
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Send us your specifications. Ask for estimates on any type or quantity.

You can depend on precision work to your most exacting specifications when you make Perkins responsible for the production of your worm, helical, spiral and bevel gears.

High precision and uniformly high quality are duplicated on every order for Perkins Gears regardless of the quantities involved.

As specialists in gears for precision work, Perkins offers you Custom Cut Gears that insure the utmost in efficiency, long service and economy.

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Cut Gears for Over 50 Years

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Almost every Conceivable Type of Gear

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Bilgram Gear & Machine Works

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THE HARTFORD SPECIAL MACHINERY CO., Hartford, Conn.

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Gear Hobbing - Thread Milling - Broaching

THE ADAMS COMPANY (*Est. 1883*) 1900 Bridge St. Dubuque, Iowa

WORM GEARING

10 to 64 D.P.

High precision

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A few pieces or a million.

As you want them —
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For fractional H.P. applications of all kinds. Speed reducing gears in the smaller range . . . *Special* facilities for GRINDING and POLISHING worm and screw threads before or after hardening.

ALSO SPURS — SPIRALS — BEVELS

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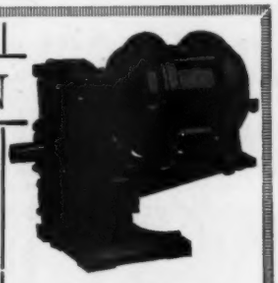
SPEED REDUCERS

Efficient—Durable—Compact

Equipped with Timken Bearings and Helical Gears. Made in sizes for motors from ½ to 15 hp. Ratio from 2½ to 1 to 1014 to 1.



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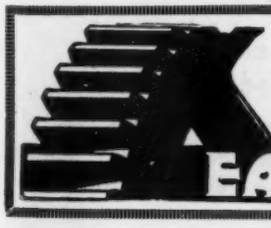

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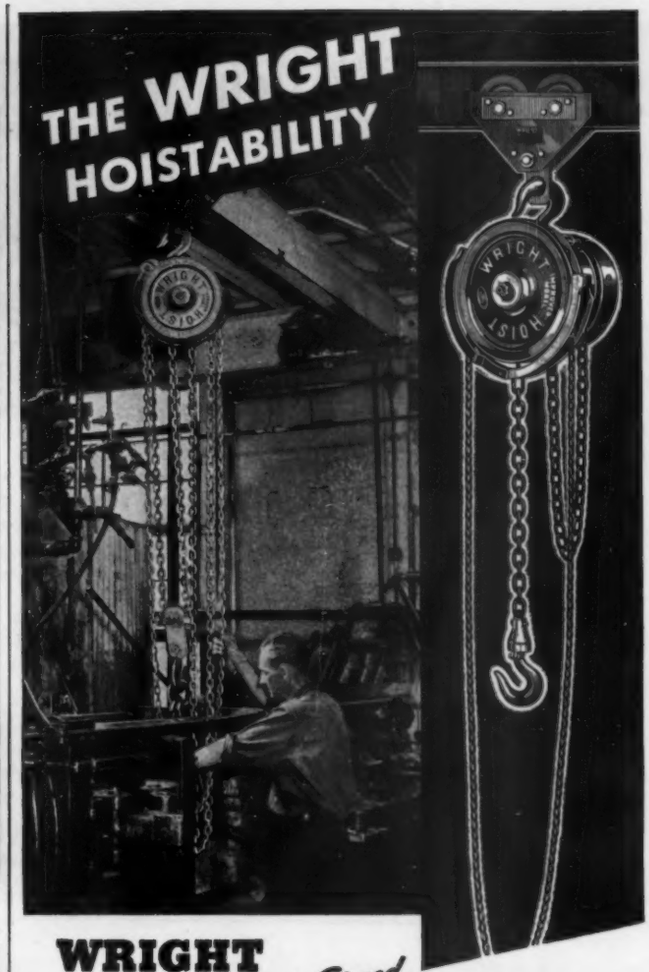

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HAVE "HOISTABILITY"

which means vertical transportation with *speed*, *economy* and *safety*.

Every WRIGHT *Improved High Speed* HOIST is *fast*, smooth and positive in action—because of Wright precision load wheel and driving spindle bearings. It is *economical*, being highly resistant to corrosion because of its full zinc coating.

It is *safe* with a load chain that stays in the pocket, regardless of operating position—because of the Wright safety guard.

Furthermore, the load chain has a safety factor of 7 to 1, and is made of a special process steel which permits it to elongate (under overload) 3" to the foot before breaking. Likewise the bottom hook will slowly open so that anyone can see the danger when loaded beyond the elastic limit of the chain.

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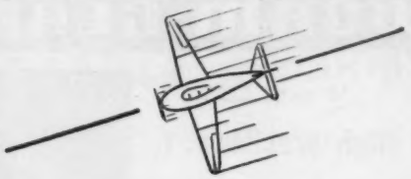
SPEED ORGANIZATION OF YOUR PRODUCTION SET-UP with

"Hallowell" STEEL BENCHES



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THE "HALLOWELL" LINE
Complete, standardized
OVER 1300 STYLES AND SIZES IN STOCK FOR PROMPT DELIVERY

WOBBLE-FREE STEEL LEGS. Sturdy steel, flanged leg construction is permanently rigid—can never get wobbly. And, these pyramid-type legs need not be fastened to the floor; the bench sets firm and steady, yet is flexible as to re-arrangement at any time.

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QUICKLY TAKEN APART, EASILY MOVED. Shop to be re-arranged? If there are crowded spots to get through just remove nuts and bolts—take the bench apart—move—and re-set-up where needed. But don't try this with an ordinary wooden bench—you'll have only a pile of kindling!

KNOW WHAT YOU PAY! Specify "Hallowell" benches and know your FULL COSTS in advance! No time and trouble in laying out—no figuring of lumber and labor costs. *And "Hallowell" benches are priced to invite the order of the canniest Buyer!*

Pat'd and Pat's Pending
Fig. 732. Drawer is extra.

COMPLETE CATALOG and price list fully describes benches, yours FREE on request to—

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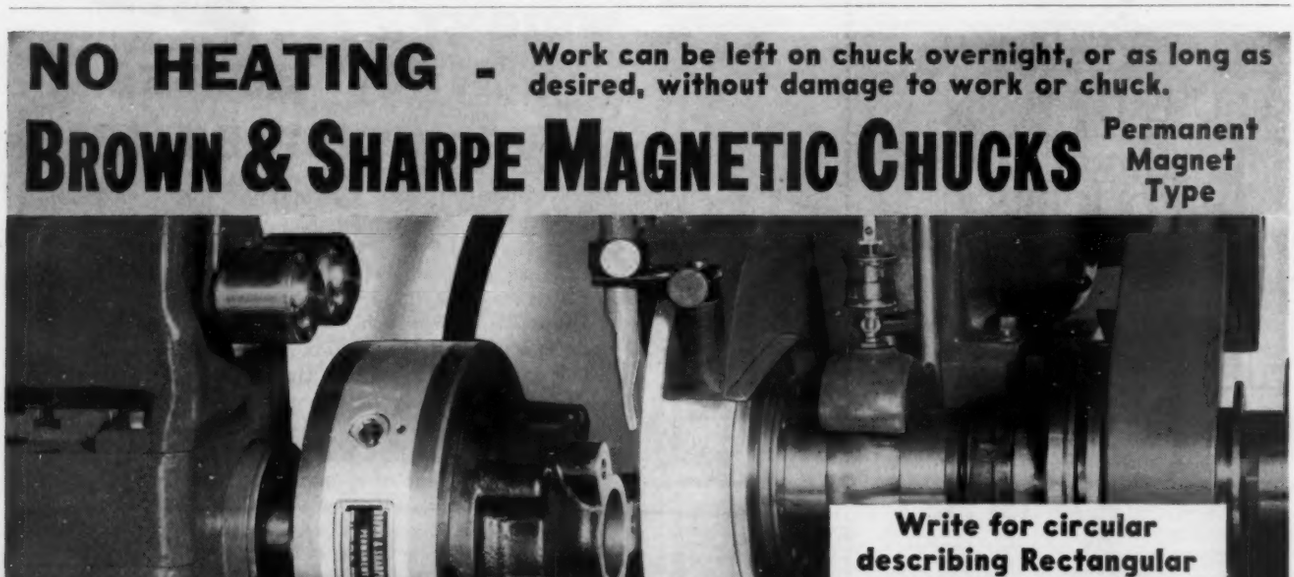

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2 PRESSES. Perkins Machine Co., Warren, Mass. Bulletin 40 illustrates with complete specifications Perkins line of Model B inclinable power presses. Each machine and its features illustrated.

3 THREAD-MILLING MACHINES. The Hanson-Whitney Machine Co., Hartford, Conn. Catalogs on 4x9, 8x16, and 10x24 in. universal semi-automatic thread milling machines. Large illustrations with complete descriptions of parts and particular advantages. Specifications and accessories shown.

4 PLANERS. Liberty Planer & Mfg. Co., Hamilton, Ohio. 12-page catalog 152 on Liberty Planers. Shows latest engineering developments in large illustrations, diagrams and specification charts. Describes details which increase operator's output.

5 TOOL-ROOM GRINDERS. Boyar-Schultz Corp., Chicago, Ill. 6-page folder on cost reducing tools for tool room. Describes and illustrates bench and floor type grinding machines and special mounted grinding wheels. Diagrams and specifications.

6 PRESS BRAKES. Verson Allsteel Co., Chicago, Ill. 6-page folder on Vernon "T" Series major press brakes. Fully illustrated with specifications and list of special features incorporated in machines.

7 BROACHES. Oilgear Co., Milwaukee, Wis. 16-page bulletin 24001, on Oilgear fluid-power, variable-speed, double-slide, vertical surface-broaching machines with automatic shuttle table. Describes construction, advantages and complete details with diagrams and charts of specifications. Actual work done by machine is diagrammed and shown in pictures. Bulletin 23001 describes in same way Oilgear single-slide, vertical surface-broaching machines.

8 FINISHING MACHINES. Ultra-Lap Machine Co., Detroit, Mich. 4-page folder illustrates and describes performance of Ultra-Lap machines. Discusses superiority and efficiency and lists various parts for which it is particularly suitable.

9 DUPLICATORS. Detroit Universal Duplicator Co., Detroit, Mich. 12-page catalog describes in detail Detroit Universal Duplicator Control for use in controlling machine tools and providing accurate duplicating control permitting reproduction of original model directly in metal. Folder shows applications of units as applied to turret lathes, planers, shapers, millers, etc. Shows advantages when skilled machinists scarce.

10 TAPPING MACHINES. The Hill Acme Co., Cleveland, Ohio. 8-page folder on Acme modern tapping machines with large illustrations and clear specification charts showing operation. Acme tap sockets and taps are also described.

11 MILLING MACHINES. W. B. Knight Machinery Co., St. Louis, Mo. 27-page plastic bound catalog on line of Knight milling machines, uses large illustrations and discusses features carefully. Performance described and diagrams show typical jobs done on these machines. Diagram of construction details and accessories listed.

12 TOOL GRINDERS. Oliver Instrument Co., Adrian, Mich. 12-page catalog on Oliver Ace universal tool and cutter grinders. Shows with large illustrations ease with which machine can be used. Actual performance data illustrated and described. Specifications for machine given.

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13 CUTTING TOOLS. Carboloy Co., Detroit, Mich. 12-page midget manual for operators contains complete information on speeds and feeds to be used with this material in varying depths of cuts and other valuable information on use and grinding.

14 GRINDING FIXTURE. Roan Mfg. Co., Racine, Wis. Folder describes new Roan grinding fixture with illustrations for use with end mill, counterbores, hollow mills, and other facing tools. Production advantages and complete description of machine with price included.

15 TOOL HOLDERS. Elk Tools, Inc., New York, N. Y. Folder describes Elk universal toolholders, giving features and advantages. Many different types are illustrated, individual use diagrammed, showing how it holds tool in various cutting positions.

16 GRINDING WHEEL SPARKS. Norton Co., Worcester, Mass. 8-page folder describes in diagrams and charts spark characteristics from grinding wheels in various metals. Shows how spark testing may be used as rapid and economical method of classifying iron and steels. Also usefulness in judging correct cutting speeds.

17 CEMENTED CARBIDE TOOL GRINDING. Carboloy Co., Detroit, Mich. 16-page bulletin GT-127, discusses grinding cemented carbide milling cutters and end-cutting tools. Gives information on grinding machines, grinding wheels, wheel mountings, wheel use, tooth rest with complete charts and diagrams of exact information. Diagrams recommend tooth profiles. Discusses general inspection and handling of cemented carbides. Includes separate charts for grinding of milling cutters and grinding of end-cutting tools.

18 MILLING MACHINE ATTACHMENTS. Porter-Cable Machine Co., Syracuse, N. Y. Folder describes Porter-Cable universal milling machine attachments for hand and power feed millers. Illustrations show use. Specifications given.

19 CHUCKS. Modern Tool Works, Rochester, N. Y. 8-page bulletin M-101 on Modern-Magic chucks and collet equipment. Large illustrations show them in actual operation. Available sizes and types fully described.

20 REMOTE TRANSMISSION. The Brown Instrument Co., Philadelphia, Pa. 24-page catalog No. 9400 tells how, why, when and where the pneumatic remote transmission can be applied for indicating, recording and control of temperature, pressure, flow and liquid level in hazardous atmospheres where use of electrical transmission is not desirable nor permissible. Gives operating features and description of working parts with large, clear photographs.

21 CUT-OFF WHEELS. Norton Co., Worcester, Mass. 10-page folder gives suggestions for best results in use of abrasive cut-off wheels on Delta cutting-off machine. Information on speed of wheel, burrs, burning, hardening, wheel flanges, machine capacity, dressing and truing, clamping the work, and general recommendations.

22 GAGES AND INDICATORS. B. C. Ames Co., Waltham, Mass. 40-page catalog 52 on Ames gages and dial indicators for impersonal measuring, size control and general testing. Complete line is illustrated. Description given and working parts carefully described and illustrated. Very complete and valuable gage catalog.

HEAT-TREATING AND WELDING

23 RESISTANCE WELDERS. Thomson-Gibb Electric Welding Co., Lynn, Mass. Folder describes line of standard Thomson spot welding, welding presses, and flash welders. Illustrations and descriptions given.

24 GAS-CUTTING MACHINES. Air Reduction Sales Corp., New York, N. Y. 8-page catalog on No. 10 Pianograph, a shape-cutting machine of the pantograph type for single or double torch operation. Gives cutting speed, cutting range, and many other exclusive and valuable features of this machine.

PLANT SERVICE EQUIPMENT

25 INDUSTRIAL BRUSHES. The Fuller Brush Co., Hartford, Conn. 8-page folder describes Fuller Steelgript brushes for industrial and engineering needs. Illustrates brushes and their uses and how they can be used to cut production costs.

PARTS AND MATERIALS

26 SWITCHES. Mu-Switch Corporation, Canton, Mass. 4-page folder illustrates original-patented, quick-action, light-pressure, precision switches. Features are listed and many applications described. Dimensions and list prices given.

27 SPEED VARIATOR. General Electric Co., Schenectady, N. Y. 4-page folder on d-c speed variator, an all-electric adjustable speed drive operating from a-c supply, in sizes from 1 to 15 hp. Describes advantages, uses, and operation, giving elementary diagram of its set-up. GEA-3517.

28 INCONEL. International Nickel Co., Inc., New York, N. Y. 16-page Bulletin T-7 on engineering properties of Inconel. Gives revised information of mechanical properties at ordinary and elevated temperatures. Gives minimum requirements of U. S. Navy specifications and data for limiting service temperatures. Approximate conversion curves for Brinell, Rockwell and Vicker's hardnesses. Sections on working properties and corrosion resistance included.

29 STAINLESS STEEL. Allegheny-Ludlum Steel Corp., Pittsburgh, Pa. 28-page Allegheny-Ludlum Blue Sheet on fabrication of Allegheny stainless steels. Gives information on its welding, drawing and blanking, machining, spinning, upsetting and forging, riveting, shearing, soldering and brazing, annealing and heat treatment, grinding, polishing and buffing, and surface treatment. Complete manual.

30 AMPCO METAL. Ampco Metal, Inc., Milwaukee, Wis. 12-page article on controlled aluminum bronze for aircraft parts, describes use of Ampco aluminum bronzes as essential alloys for aircraft industry. Well illustrated by photomicrographs, views of aircraft parts, charts and tables. Valuable information.

31 TIMERS. National Time & Signal Corp., Detroit, Mich. 8-page folder on National Timers for holding industrial processes in line. Describes welding timer for spot welding, seam welding and the like. Production advantages described.

32 SPEED CONTROLS. Reeves Pulley Co., Columbus, Ind. 10-page booklet G-410 on Reeves speed controls for machine tools. Gives uses and advantages on machine tools with six pages of typical installations with production details. Fully illustrates and describes three Reeves speed control units.

33 PRE-FINISHED METALS. American Nickelold Co., Peru, Ill. Folder describes pre-finished metals which require no plating or polishing and thus speed up production. Describes facilities and includes actual metal sample for inspection.

34 STEEL SHAPES. The Commercial Shearing & Stamping Co., Youngstown, Ohio. Booklet on standard steel shapes illustrates and describes circular steel shapes obtainable as standard items, thus eliminating tool and die expense. Describes economy of purchasing them rather than setting up production facilities.

35 MACHINE TOOL DRIVES. Robbins & Myers, Inc., Springfield, Ohio. 4-page folder describes R & M drives and how they meet actual needs in efficient machine shop operation. Specifications given and illustrations show R & M drives as applied to machine tools.

36 BALL BEARINGS. Landis & Gyr, Inc., New York, N. Y. 6-page bulletin 3 describes R.M.B. miniature ballbearings ranging in outside diameter from 1.5 millimeters to 20 millimeters. Discusses design and construction, load capacities, and extremely low friction factor. Each design series diagrammed with available sizes listed.

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It's a rotor that does more than meet the tempo of today's industrial needs . . . it sets a *new standard* of motor performance. For *only in this rotor* are the advantages of a one-piece winding combined with the advantages of *copper.*

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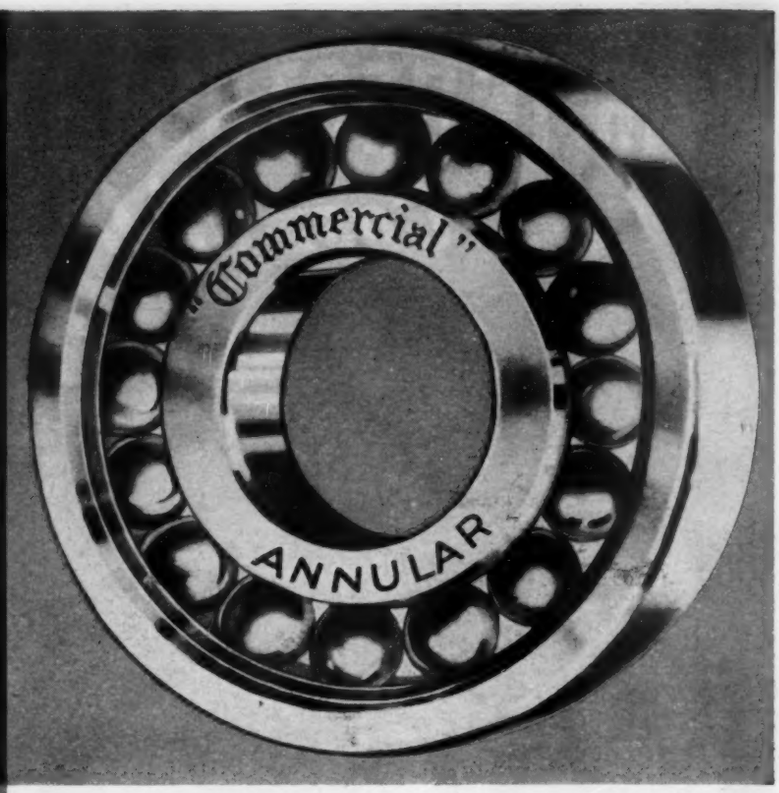

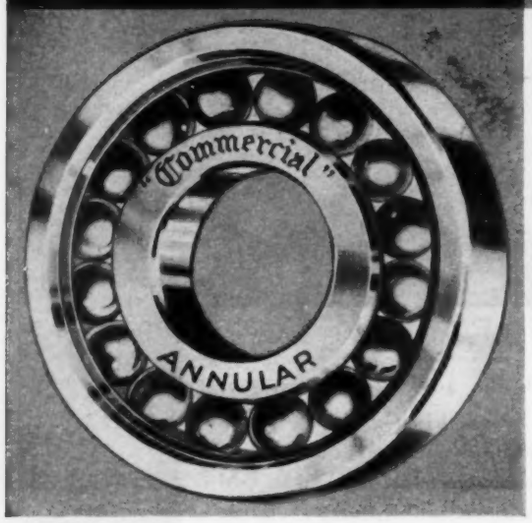

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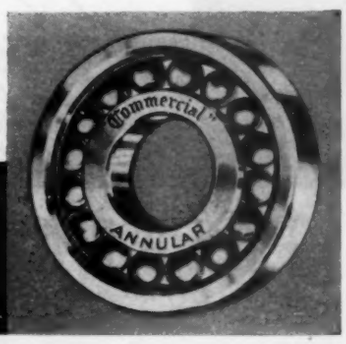
OUR Engineering Staff will be pleased to assist in making recommendations regarding the *correct* type of bearing for any product you make, or any machine you operate. Write for complete information and latest catalog.



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GREATER SAFETY

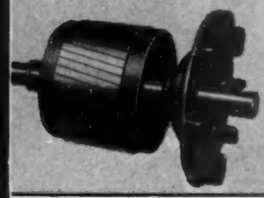
Unlike cast iron, the rolled steel frame and malleable base give REAL PROTECTION against external blows and accidental abuse. No moving parts exposed as in ordinary open motors.

STREAMLINED

A motor in the modern mode — "EYE APPEAL" with a wallop! All exterior surfaces smooth and graceful — not one unsightly sharp corner — no visible openings!

OTHER PLUS VALUES

Stator windings are triple-treated with HOWELL-BOND Insulating Varnish — baked on. HOWELL-BOND is oil, grease and water-proof.



Rotor is of a copper bar construction with bars and end rings welded into one PERMANENT assembly.

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This new HOWELL Motor is revolutionary, a premium motor if there ever was one — yet HOWELL Research and HOWELL Engineering offer it to you as standard open motor construction.

The motor frame is rolled steel; base malleable iron; working parts TOTALLY encased, except for ventilation openings . . . extra protection against physical damage . . . extra protection against the grief that moisture can cause. And so expertly is ventilation accomplished that cool-running is assured, as proved by exhaustive tests.

Use these new HOWELL Protected Type Motors — and obtain a standard of performance and appearance you never before thought possible . . . integral sizes up to 5 HP now available — larger sizes later.

Save maintenance expense; avoid costly shutdowns! Send for this Bulletin which fully explains our New Protected Motor, a remarkable development.

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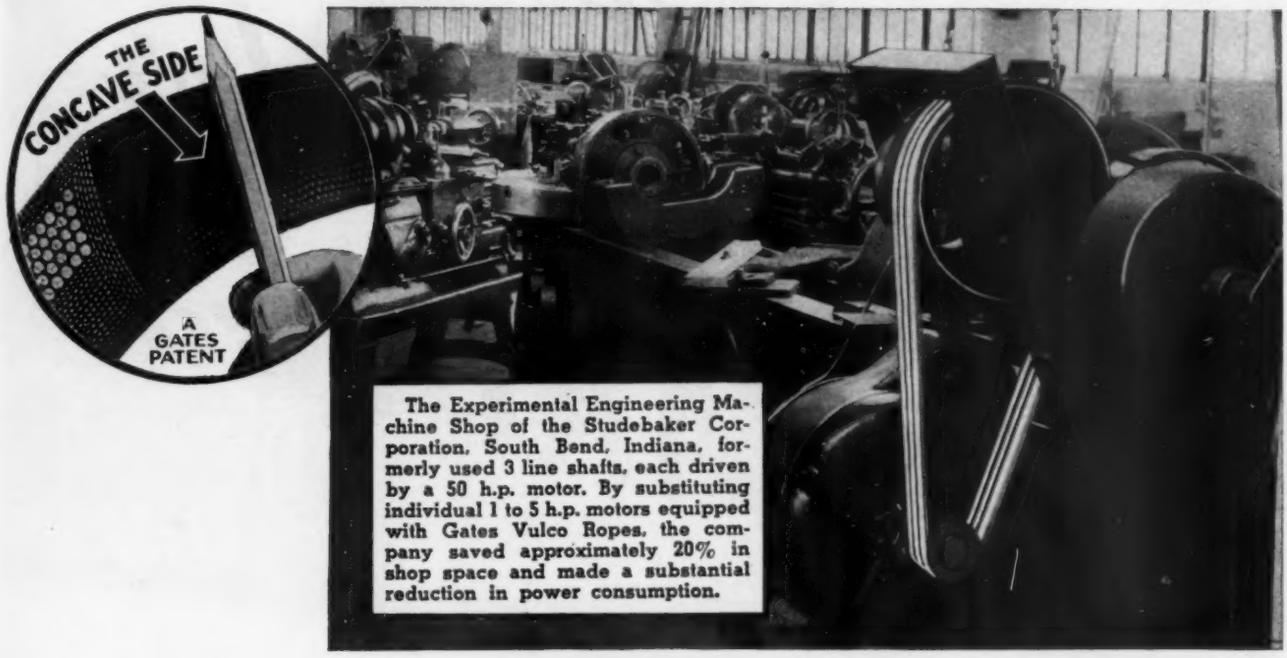

The Experimental Engineering Machine Shop of the Studebaker Corporation, South Bend, Indiana, formerly used 3 line shafts, each driven by a 50 h.p. motor. By substituting individual 1 to 5 h.p. motors equipped with Gates Vulco Ropes, the company saved approximately 20% in shop space and made a substantial reduction in power consumption.

Here's an Easy Way to *See for* YOURSELF

HOW THE CONCAVE SIDE *Saves Money!*

What Happens When a V-Belt Bends

FIG. 1

FIG. 2

If you use V-belts you cannot spend two minutes more profitably than in making this simple test:—

Pick up *any* V-belt that is built with *straight* sides. Bend it as it bends in going around a pulley. You will see that the top of the belt grows *narrower,* the bottom *wider*—and the sides of the belt *bulge out.* The straight-sided belt, when bent, takes the shape shown in figure 1, at left. Clearly, this shape does not fit the sheave groove.

Now make the same test with the belt that is built with the patented concave side. As this belt bends, you will see it take the shape shown in figure 2—a shape that precisely fits the sheave groove.

Two savings result. First, no outbulge of the sides means uniform sidewall wear—longer life for the belt. Second, the full side of the belt uniformly gripping the sheave wall will carry heavier loads without belt slippage—a saving in belt wear and also in power!

The Gates Vulco Rope is the only V-belt built with the patented concave side.

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ARE DESIGNED, BUILT AND TESTED AS *Complete* UNITS

Hundreds of installations in widely diversified industries have proved the outstanding advantages of Westinghouse Gearmotors for slow speed drives. Gearmotors save installation costs and reduce maintenance expense because no belts, pulleys or sprockets are required. The exact output speed can be obtained by simply installing one unit. And with a Westinghouse Gearmotor, low output speed is provided with the full efficiency of a high speed drive—efficiency ranging from 94% to 98%.

The design and construction of Westinghouse Gearmotors make it possible to solve many slow speed drive problems economically. Westinghouse Gearmotors are built as one complete unit. The result is a balanced drive in which all parts are matched to provide maximum results. Smooth, quiet operating gears are assured because Westinghouse makes its own gears—gears that are accurately cut from forged steel and heat-treated by the exclusive Westinghouse BPT process.

Built as one complete unit with all parts accurately balanced and matched, a Westinghouse Gearmotor will deliver its full torque under load and withstand the shocks of even the most severe service conditions.

Gearmotors are available in all standard motor ratings and in a wide variety of special enclosures. Your Westinghouse representative will be glad to give you complete details.

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WESTINGHOUSE ELECTRIC & MFG. CO.
EAST PITTSBURGH, PA

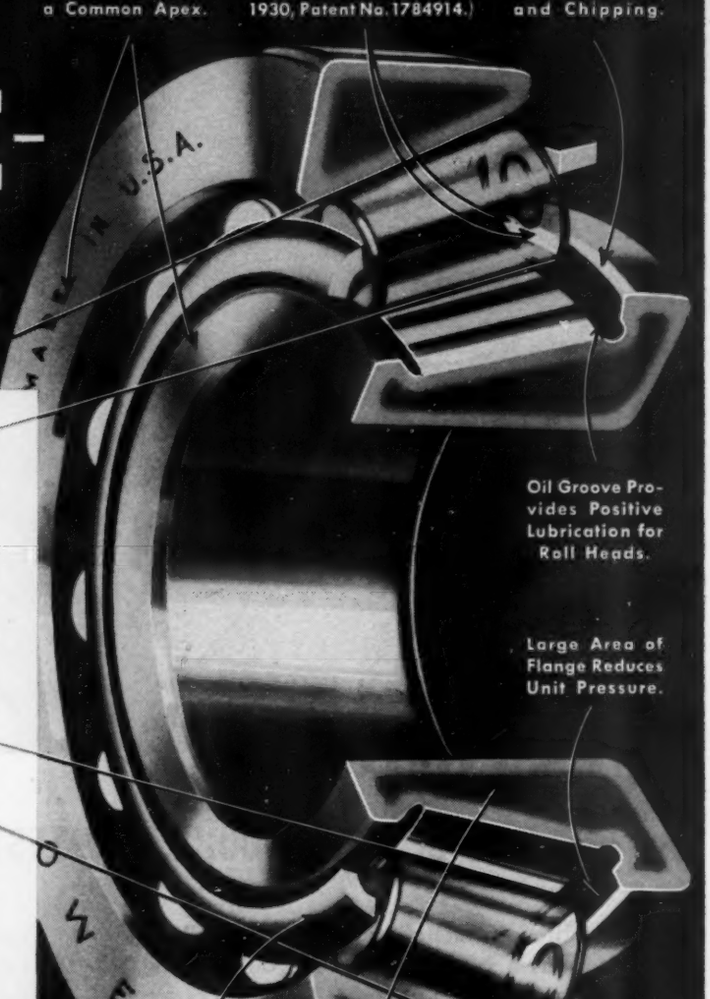
See the Westinghouse Exhibit - - booth 179 - - American Society of Tool Engineers Show - - Convention Hall, Detroit, Michigan - - March 24 to March 29.

J-07171

Westinghouse
GEARED DRIVES

OF FIRST IMPORTANCE—

Design


Full Line Contact of Final-Finish Surfaces Coincide on a Common Apex.
Two-Zone Contact of Roll End Insures Roll Alignment. (Patented Dec. 6, 1930, Patent No. 1784914.)
Ground Radius of Cone Flange Prevents Noise and Chipping.
Oil Groove Provides Positive Lubrication for Roll Heads.
Large Area of Flange Reduces Unit Pressure.
Multiple Perforated Retainer for Roll Spacing.
Case Hardened Alloy Steel Cup and Cone.

THIRTY-SIX years of Roller Bearing manufacture have proved that design is the most important element in a bearing.

Likewise, the use of many millions of Bower Roller Bearings as original equipment over a period of many years in America's leading large-production automobiles has proved the correctness of BOWER DESIGN.

Bearing users will appreciate that the exacting standards of the automotive industry and the severe usage of bearings in automobiles offer a challenge that no roller bearing can meet unless it possesses the highest degree of quality known to the bearing industry.

One of the secrets of Bower's leadership is the fact that its technical men have never waited upon the ingenuity of other men. Bower engineers push relentlessly ahead—far beyond the needs of the moment—to make new technical discoveries and to apply them always in ADVANCE.

This Tapered Roller Bearing is a leading example of Bower design. It embodies important advantages that no other bearing possesses—advantages that Bower engineers discovered and incorporated ahead of all others.

For more detailed information on Bower design, ask us for a copy of the folder, "Secrets of Bower Roller Bearing Design and Quality."

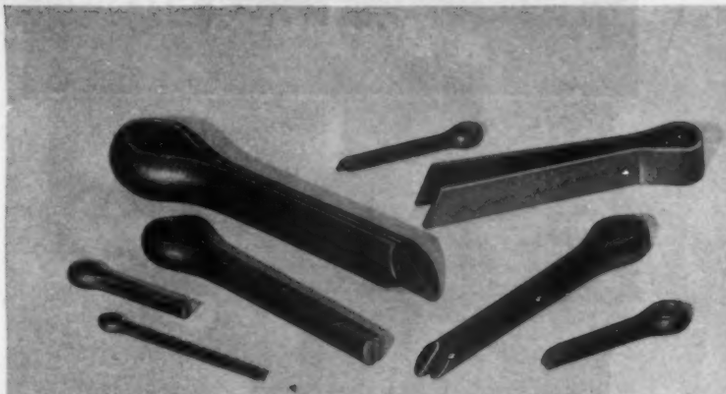
BOWER
ROLLER BEARING CO.
Detroit, Michigan

Bower Finish Like A "Face-Lifting" Operation

1. ROUGH GROUND—Photomicrograph—25 diameters—showing amorphous film with roughness of approximately 15 micro-inches (millionths of an inch). **2. FINISH GROUND**—More but finer scratches—surface finish of approximately 10 micro-inches composed of amorphous metal left by finish grinding—Photomicrograph of 25 diameters. **3. FINAL FINISH**—25-diameter photomicrograph showing amorphous metal and grinding marks removed, baring hard surface and smoothness of approximately 3 micro-inches—scratches below surface.

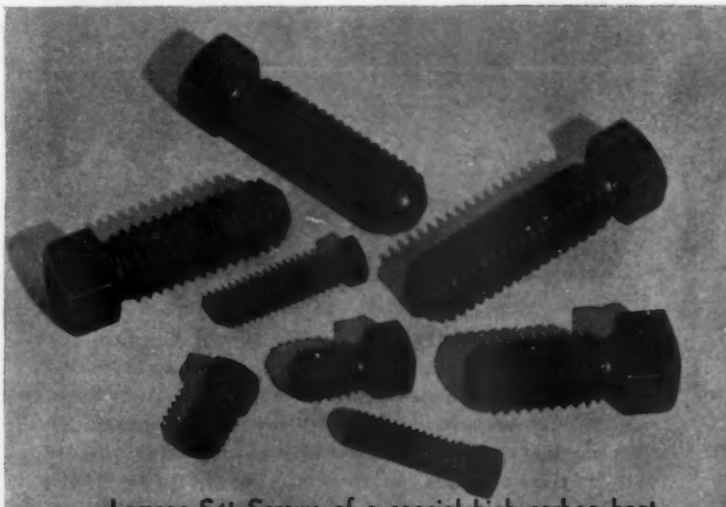
ALL ON ONE INVOICE AND IN ONE *Shipment*

Milled and rough Studs are stocked in popular sizes. When physical requirements and raw materials are specified, made to order in production quantities of carbon or alloy steel, or non-ferrous alloys, from ¼-inch to 1½-inch diameters, any length.



A blow on the diamond-shaped head of Lamson Cotters spreads prongs. "Efficiency" points serve as a drift pin. Lamson stock cotters conform to all Government specifications. Cotters made to order from brass, bronze, aluminum and stainless steel.

Lamson full finished Cap Screws of SAE 1020 steel have approximately 90,000 lbs. per sq. in. *minimum* tensile strength. Our high carbon cap screws of SAE 1035 steel, heat treated, have approximately 150,000 lbs. *minimum* tensile strength.



Lamson Set Screws of a special high carbon heat treated steel compare favorably with much higher priced alloy steel set screws in performance. Cost you no more than common low carbon set screws available heretofore.

● As manufacturers of the most complete line of bolt and nut products in this country, Lamson & Sessions can fill an order for a wide variety of standard fastenings out of warehouse stocks. And a nation-wide network of responsible jobbers re-inforces these facilities for your demands. Obviously, it is least costly of time, effort and expense to order every fastening you need—*in one shipment, at one time, on one invoice, from one manufacturer.* And next best to that is specifying the Lamson line when you order from your mill supplies dealer or hardware jobber—for the quality is exactly the same—backed by 75 years of bolt-making experience.

THE LAMSON & SESSIONS COMPANY, Cleveland, Ohio

Plants at Cleveland and Kent, Ohio; Chicago and Birmingham

Your Jobber stocks the Lamson line

LAMSON & SESSIONS

BOLTS • • NUTS • • COTTERS • • CAP SCREWS • • SPECIALS

They'll work a 24-hour shift

and charge no OVERTIME

SPEED-UP is the order of the day for American industry. Overtime and extra shifts place an added burden on machines and power transmission lines.

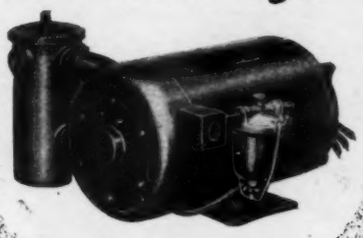
Accurate, sturdy BCA Ball Bearings are insurance against costly shut-downs for repairs or replacements of the machines you operate. They are an assurance of trouble-free operation, too, in the machines which you make and sell.

Every BCA Ball Bearing is designed right—made of the right materials for the service indicated in the BCA Data Book. If your designer and plant engineer do not have a copy of this quick reference book, write and we will send it to you, quick.

BEARINGS COMPANY OF AMERICA
415 HARRISBURG AVENUE • LANCASTER, PENNSYLVANIA

BCA RADIAL · ANGULAR CONTACT · THRUST *Ball Bearings*

more compact
no needless weight



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PUMPS
For VACUUM or PRESSURE

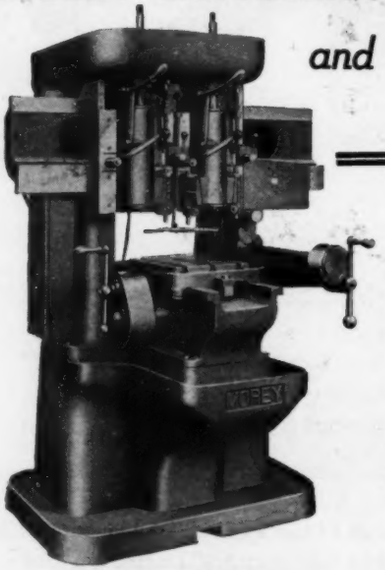
NO PULSATION
NO DRIVES
NO BELTS
NO GEARS
NO GUARDS

LONGER LIFE *at* LESS COST!
Made in one integral unit saves wear and parts replacement. Patented *visible* oiling system for cleaner air. More power at a given input. Get facts and you'll get Moto-Air!

Write for Catalog!

NEW JERSEY MACHINE CORPORATION
1500 Willow Ave., Hoboken, N. J.

MOREY No. 12M HIGH SPEED VERTICAL PROFILER and MILLER



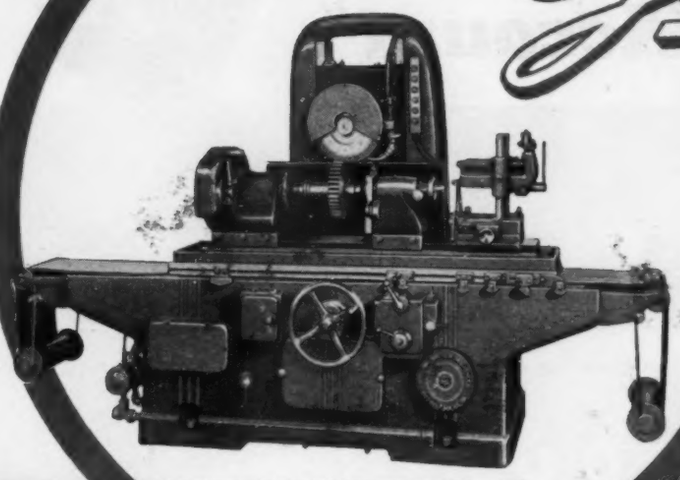
Production of inter-changeable parts requiring milling of any contour or outline can be materially speeded up by this Profiling and Milling Machine.

"Ask for descriptive bulletin."

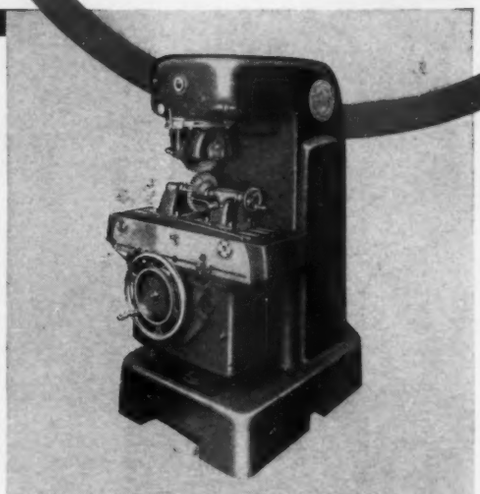
CONDENSED SPECIFICATIONS
Table working surface—12¾x15¼
Table travel—longitudinal—23"
Table top to bottom of cross slide: maximum: 11½"; minimum: 7⅛"
Table top to spindle end: minimum 4"; maximum 8 to 12"
Single spindle machine can also be furnished.

MOREY MACHINERY CO., INC.
410 Broome Street New York, N.Y.

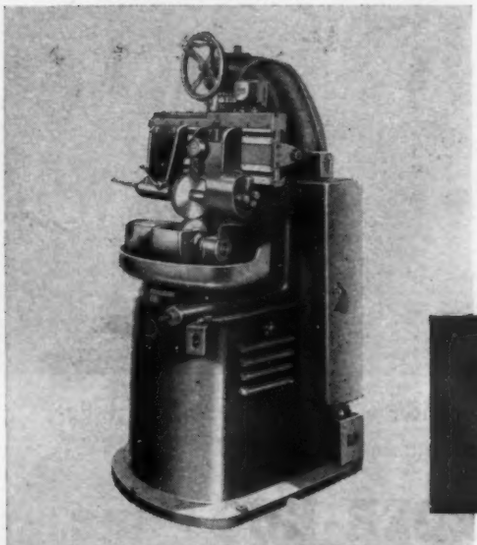
IF YOU *Grind* GEARS



HERE IS THE WAY TO *Save* BOTH TIME AND COST



RED RING GEAR FINISHING MACHINE



RED RING GEAR LAPPING MACHINE

In hobbing the gear, leave enough stock (.005" to .016") to take care of hobbing errors and fire distortion. Shave the green gear on a Red Ring Finishing Machine to eliminate hobbing errors and then harden.

After hardening, use a Red Ring Gear Grinding Machine to reduce the overall error to less than .001", but without sparking the wheel out. Sparking out accounts for at least half the time required by the grinding operation. It is entirely unnecessary when final finishing is done on a Red Ring Lapping Machine.

Lapping removes the fuzz left on the tooth surface by the grinding wheel, leaves tooth surfaces smooth and corrects all remaining errors to whatever degree of accuracy is desired.

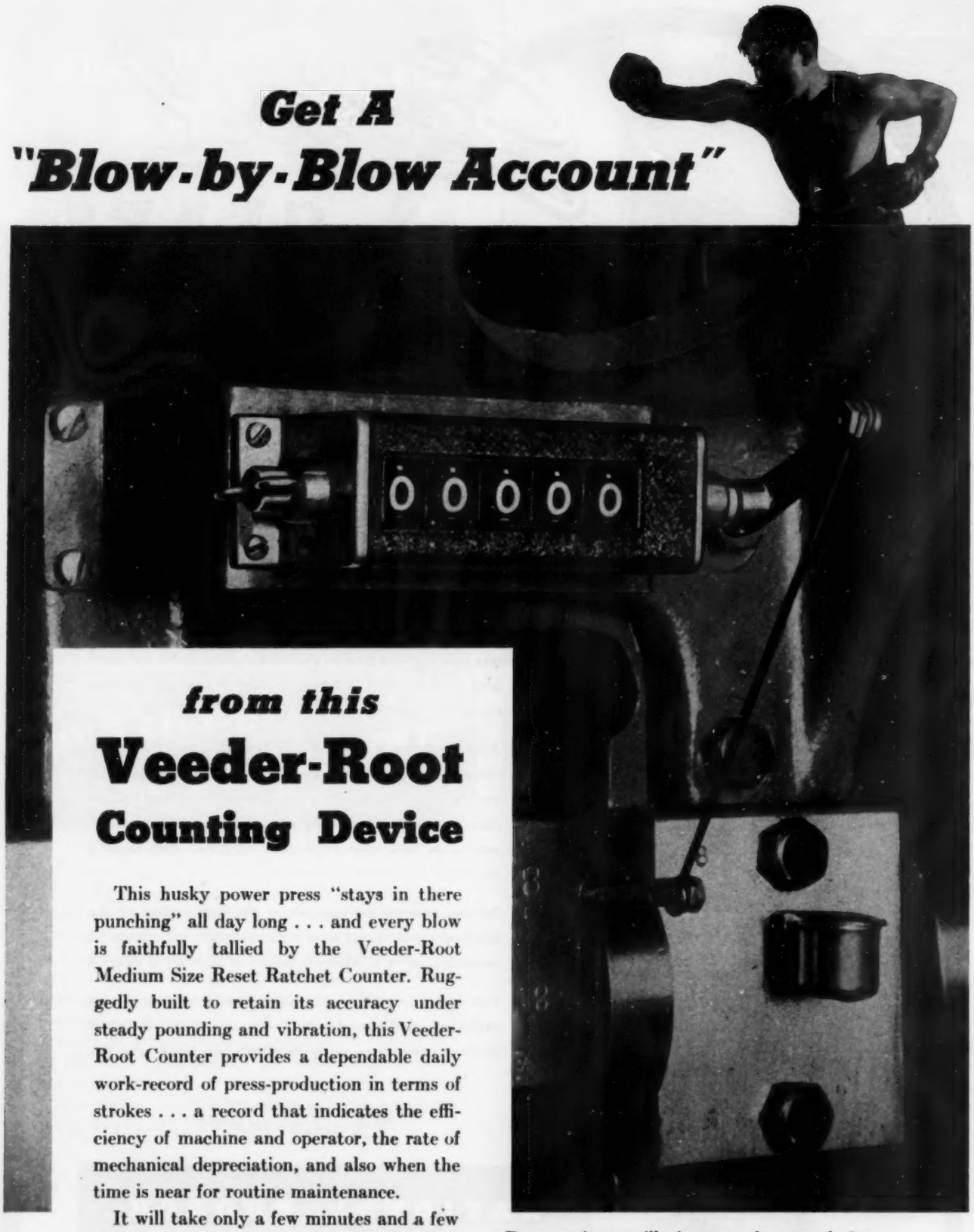
This is not only faster and more economical than relying exclusively on the grinder, but it also reduces the percentage of scrap and assures greater durability and longer gear life.

Write for bulletins on Red Ring shaving, grinding and lapping.

NATIONAL BROACH AND MACHINE CO.

5600 ST. JEAN • DETROIT, MICHIGAN

Get A "Blow-by-Blow Account"



from this Veeder-Root Counting Device

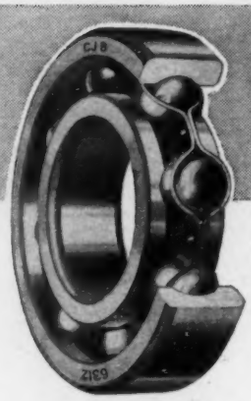
This husky power press "stays in there punching" all day long . . . and every blow is faithfully tallied by the Veeder-Root Medium Size Reset Ratchet Counter. Ruggedly built to retain its accuracy under steady pounding and vibration, this Veeder-Root Counter provides a dependable daily work-record of press-production in terms of strokes . . . a record that indicates the efficiency of machine and operator, the rate of mechanical depreciation, and also when the time is near for routine maintenance.

It will take only a few minutes and a few dollars to attach a Veeder-Root Counter to each one of your production machines . . . to provide work-records in any terms or units of performance you want . . . and to point the way to new savings. A Veeder-Root engineer will give you the actual figures on time and cost. WRITE TODAY.

VEEDER-ROOT Inc.
HARTFORD, CONN.

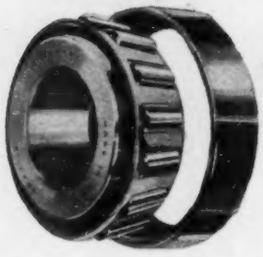
IN ENGLAND, VEEDER-ROOT LIMITED, CROYDON, SURREY • IN CANADA, VEEDER-ROOT OF CANADA LIMITED, MONTREAL, P. Q.

Your Distributor
Can Help You
Keep This Genie
GROWING!
Mars has released a productive genie greater than any the world has ever seen. That genie is Metal-Working America, with a capacity already more than two times that of Europe and now swelling to three—four—and even five times as great. It is your job to keep that genie growing steadily and surely. The greatest essential is a smooth, unbroken flow of production—and that means tools, accessories and supplies ready and waiting when they're needed. Your local industrial distributor can supply them—from over 20,000 items stocked to meet your need at a moment's notice. His readiness to help in emergency is but one phase of the continuing service he renders in meeting your production and maintenance needs for industrial supplies. Patronize your local distributor—he is trained and prepared to give you minuteman service.
MILL SUPPLIES • 330 W. 42nd St., New York, N. Y.
The Magazine for Industrial Distributors and Their Salesmen



BEARINGS *all Types*

CJB AHLBERG

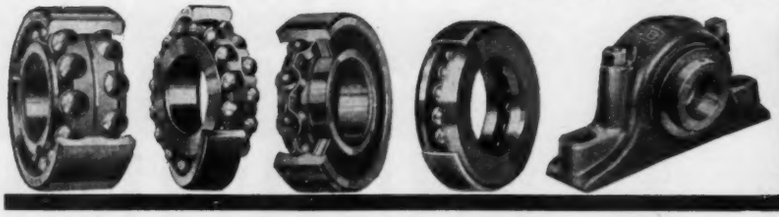


BOWER Tapered Roller Bearings

THERE are standard (CJB) Ball Bearings and Bower Roller Bearings for most applications. The higher speeds and more exacting requirements industry demands of equipment today call for better bearings. Whether you design new machines or modernize present equipment, (CJB) Ball Bearings and Bower Tapered Roller Bearings will do the job efficiently, economically and satisfactorily.

(CJB) Ball Bearings have large balls for capacity — deep grooved rings for strength—and mirror-finish raceways for smooth performance and long life.

BOWER Tapered Roller Bearing raceways are "Super-Finished" for extreme accuracy and quiet operation. Maximum capacity and long life are obtained through positive roll alignment—heavy thrust shoulder — and constant roll end lubrication.



AHLBERG BEARING COMPANY

MANUFACTURERS OF (CJB) MASTER BALL BEARINGS

3018 WEST 47TH STREET

CHICAGO, ILLINOIS

P&J

. . . the symbol of LEADERSHIP in the development of

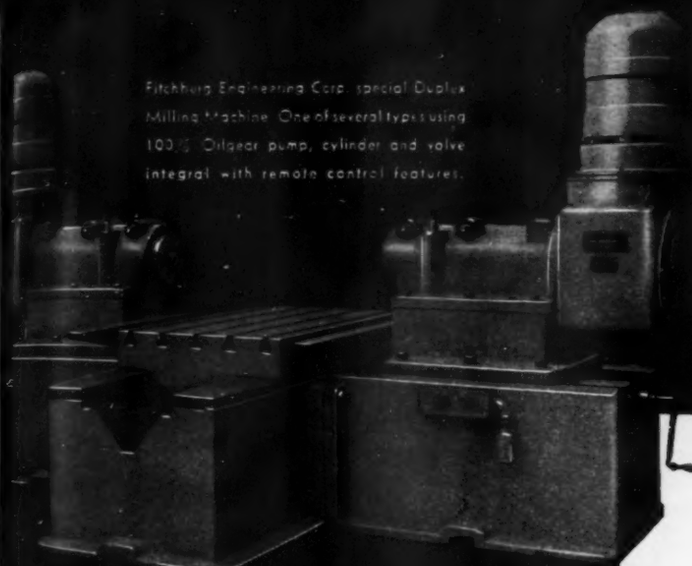
AUTOMATIC CHUCKING EQUIPMENT

The many exclusive features in design offered by Potter & Johnston are the result of over 40 years pioneering in the design and manufacture of high production automatic chucking equipment.

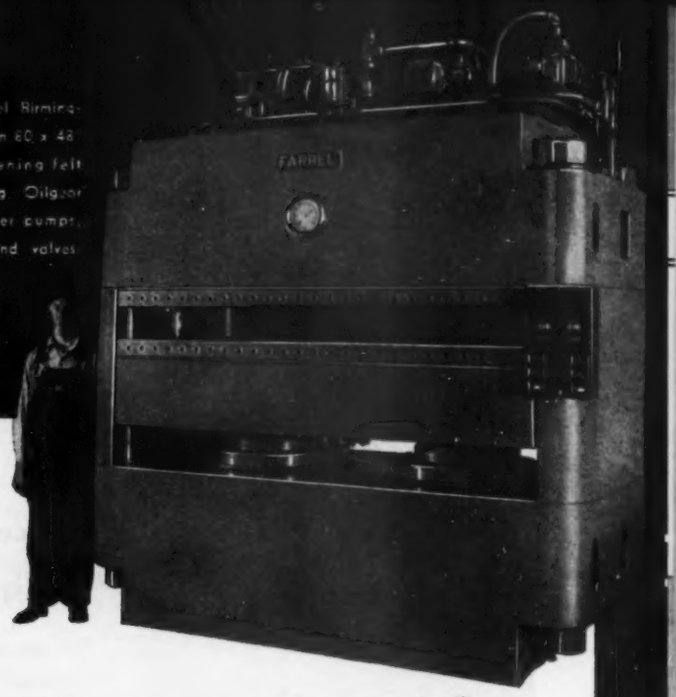
Today as always, P & J is contributing to the more and more exacting needs of the hour by rendering invaluable assistance in stepping up the production of accurate, duplicate parts.

Factory Representatives of Potter & Johnston — located in the leading industrial areas—are ready to render prompt service in helping you solve your production problems.

POTTER & JOHNSTON MACHINE COMPANY, Pawtucket, R. I.

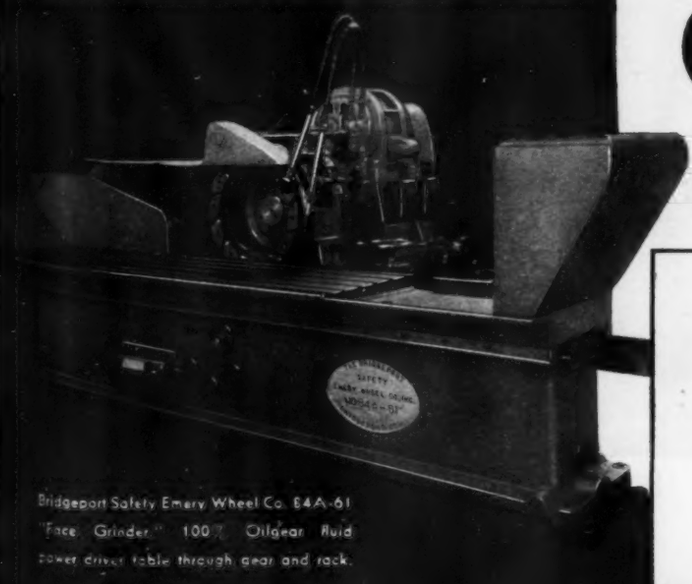


Fitchburg Engineering Corp. special Duplex Milling Machine. One of several types using 100% Oilgear pump, cylinder and valve integral with remote control features.



Right: Farrel Birmingham 926 ton 60 x 48 single opening felt press, using Oilgear Fluid Power pumps, cylinders and valves.

Baush Machine Tool Co. Multiple Spindle Drilling and Tapping Machine 100% Oilgear equipped. Said to be the first hydraulic combination machine.



Bridgeport Safety Emery Wheel Co. 84A-61 "Face Grinder." 100% Oilgear fluid power driven table through gear and rack.

There is no time for "*Time Out*" these days

Today, as never before, it is essential that production machines go right into production and *stay* in production. Busy factories have no time for "Time Out." Machine tool and machinery manufacturers themselves can't afford service complaints.

And so, machine tool and machinery manufacturers insist on having 100% Oilgear Fluid Power Equipment. They know a hydraulic system can be only as good as the pump and the cylinder and the valves. They know that all of Oilgear's unequalled experience in hydraulics goes into the design and construction of all of Oilgear Equipment. And they know that "100% Oilgear Equipped" is the strongest assurance of service they can offer their customers. Unequalled advantages result from this undivided responsibility which rests on Oilgear's leadership and fluid power achievements.

From a broad line of standard Fluid Power Equipment, Oilgear Engineers bring you "tailored to order" results that realize every objective you have in mind . . . a system that is simple to connect, operate and inspect. Oilgear *solutions protect machine manufacturers and users from every standpoint.* The urgency of the times calls for *dependable* Oilgear Fluid Power systems. Write for completely descriptive literature. THE OILGEAR COMPANY, 1307 W. Bruce Street, Milwaukee, Wisconsin.

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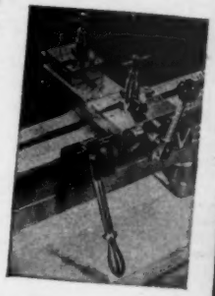
RIVETT 918 HAND SCREW MACHINE

More Precision Work

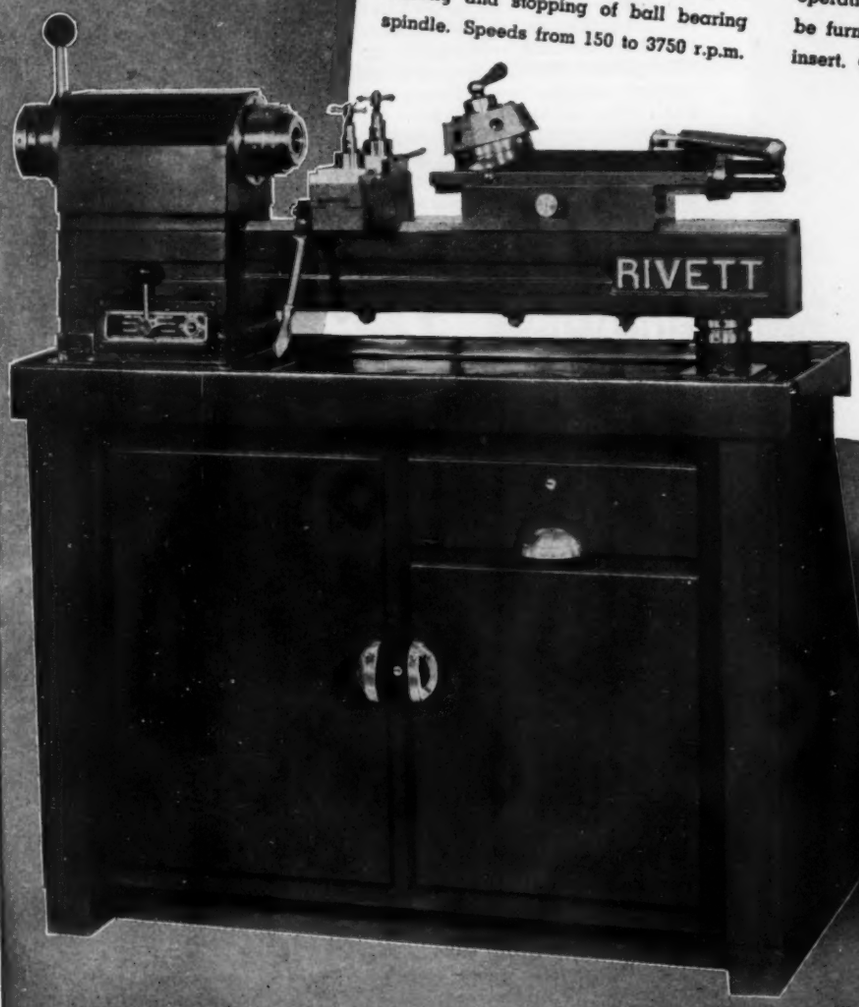
Duplicate Parts Rapidly Machined

The balanced design and operating features of the Rivett 918 hand screw machine make it an efficient producer on small precision parts. Work is accurately held in collet operated by rotary chuck closer with ball thrust bearing. Single lever controls lathe drive and automatic brake for quick starting and stopping of ball bearing spindle. Speeds from 150 to 3750 r.p.m. can be selected. Automatic indexing turret head revolves on roller bearings and is geared to independent stops. Cross slide carries tools for forming and cutting off. The machine is free from all vibration as it is properly proportioned and dynamically balanced throughout.



Parts requiring up to eight operations can be finish-machined at one chucking. Bar stock passed through spindle can be held in push-out collets up to 1" capacity while work individually chucked can be held in draw-in collets, step chucks or jaw chucks. If a turning operation is required, cross slide can be furnished with a parallel slide; see insert. Oil pump and piping is optional.

For complete information write for Bulletin 918



918 hand screw machine on metal cabinet with eight spindle speed drive.

RIVETT LATHE & GRINDER INC.

BRIGHTON, BOSTON, MASS.

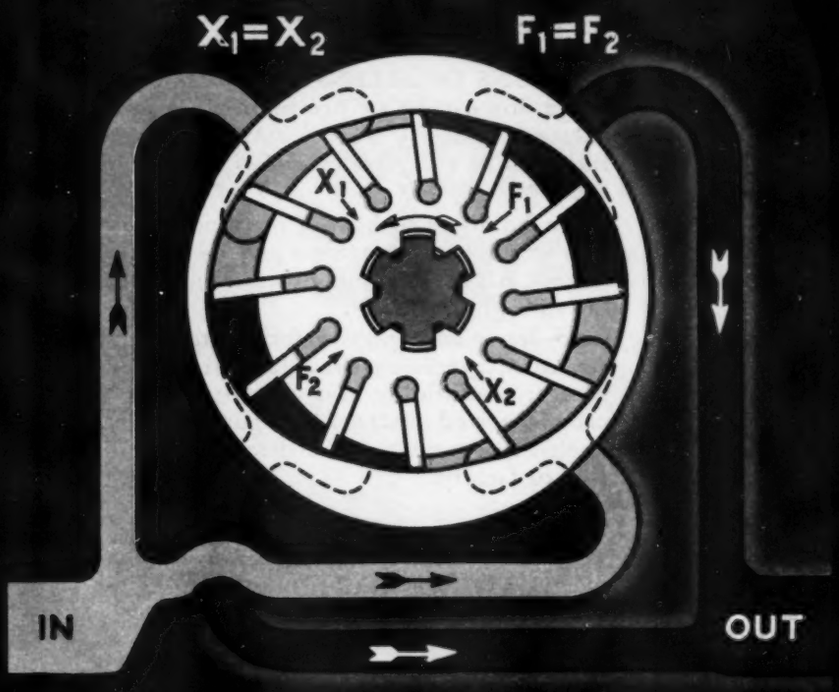


Diagram Showing Patented Hydraulic Balance Construction

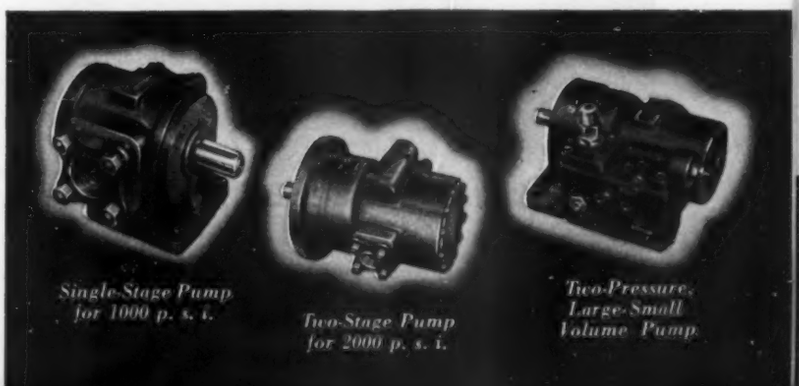
Bearing Loads are Cancelled Out

Hydraulic Balance means much

longer life for VICKERS VANE TYPE PUMPS

The diagram above illustrates the patented "Hydraulic Balance" construction that is exclusive with Vickers Vane Type Pumps. Note that the bearing loads are cancelled out by equal and opposing radial hydraulic thrust loads. Much longer pump life results from the fact that the major *cause* for wear is entirely eliminated, namely, bearing loads resulting from pressure. This construction is also one of the important reasons for the exceptionally high efficiency of Vickers Vane Type Pumps.

Application of the "Hydraulic Balance" principle is representative of the engineering development and research behind all Vickers Hydraulic Pumps and Hydromotive Controls . . . an important and continuous activity to always assure the high quality of Vickers products.



Single-Stage Pump for 1000 p. s. i.

Two-Stage Pump for 2000 p. s. i.

Two-Pressure, Large-Small Volume Pump

VICKERS *Incorporated*

1410 OAKMAN BLVD., DETROIT, MICH.

"MILLIONS FOR DEFENSE"

— but not ONE CENT for *Failure!*

MILLIONS OF ALLENS—but not one cent for machine down-time or production tie-ups through failure of hollow screws. For Allen Screws are put to the tests of *emergency conditions* in our laboratory routine!

From bombers to boring machines; from guns to gear grinders; in armament *and the machine tools that make it*, ALLENS are doing their famous job of "holding strongly together".

Cold-drawn and "pressur-formd" to new "highs" of strength; precision-threaded for greater holding-power; scientifically heat-treated; visually and manually inspected—ALLEN Hexagon Hole Products are steeled to every stress of defense operations in the field or factory.

Call your local Allen Distributor to supply these "defense units" for your machines or equipment.

Visit our exhibit (Booth 220) at the Machine & Tool Progress Exhibition, Detroit, Michigan, March 25 to 29 inclusive.

THE ALLEN MANUFACTURING COMPANY
HARTFORD, CONNECTICUT, U. S. A

For Hydraulic Installations —

the 500 Series ROTARY GEARED PUMPS with HERRINGBONE GEARS

—Quiet in operation ••• for pressures up to 500 lbs.

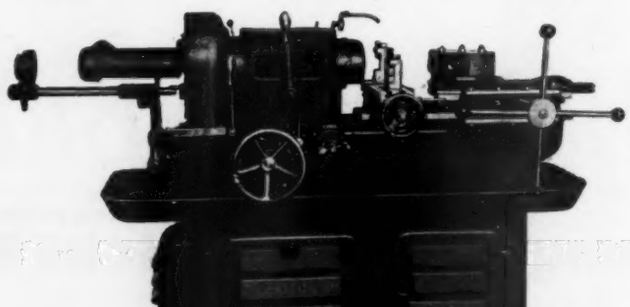
Ask for circular

Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

BROWN & SHARPE PUMPS

MOREY No. 2G TURRET LATHE

for Low-Cost Production



INFINITE SPINDLE SPEEDS
90 to 1800 R.P.M. or 180 to 3600 R.P.M.

Motor Drive—Capacity, 1" diameter, 6½" turning length.
Any spindle speed you want—a direct reading dial shows when you've got it.
Permits the use of carbide tools for fast cutting.
Patented turret clamp operates automatically.
Effective on second operation and chucking work.

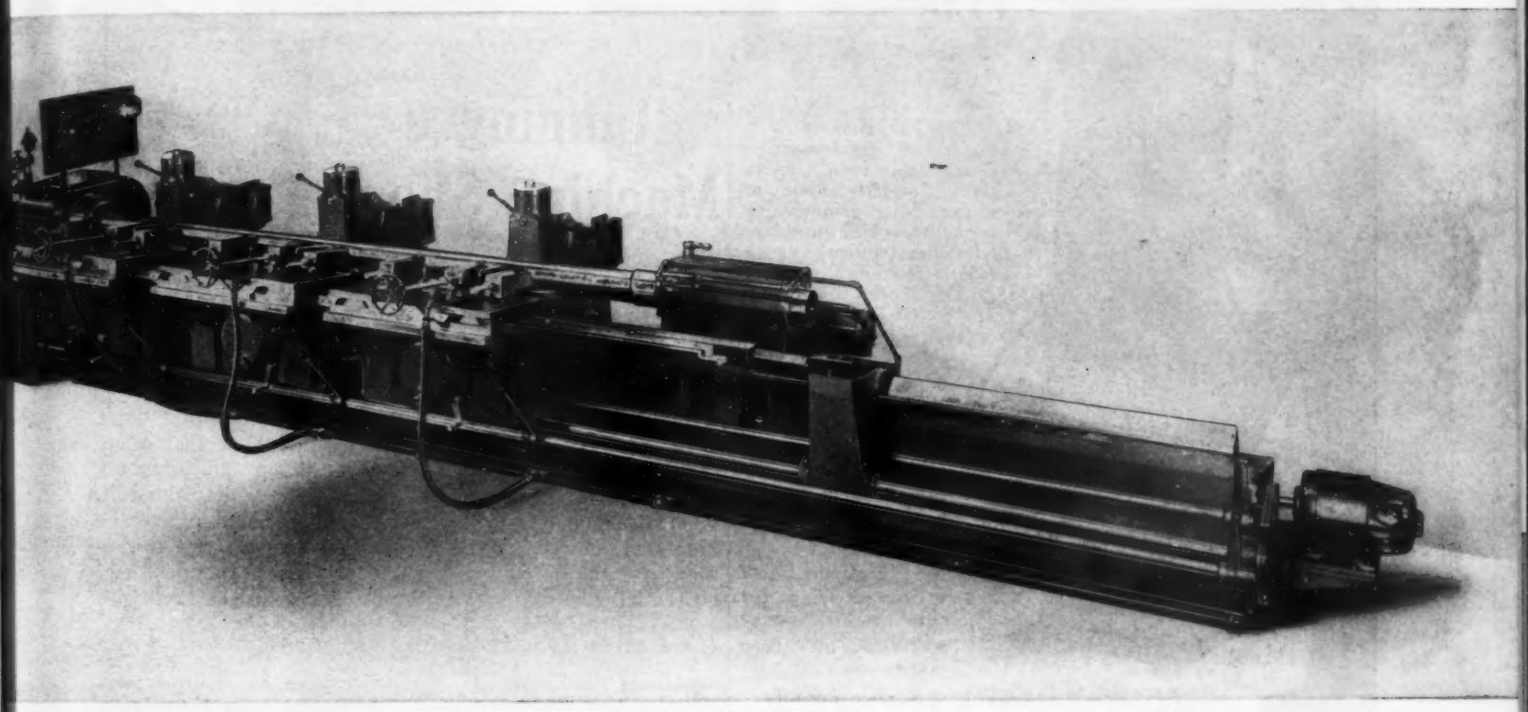
Send for a more complete description of this unusual turret lathe.
Ask for Bulletin No. 629.

MOREY MACHINERY CO., INC.
410 Broome Street New York, N.Y.

MACHINE OF THE MONTH

PREPARED BY THE SENECA FALLS MACHINE CO. "THE Lo-swing PEOPLE" SENECA FALLS, NEW YORK

NEW MODEL LS *Lo-swing* TURNS LARGE GUN BARRELS



Problem: To increase production on turning operations of gun barrels up to 14″ diameter by 21′ long. *Solution:* This job was being done on a conventional Gun Lathe. There being a limit to the speeds and feeds which the tools would stand, the only way to further increase production was to use multiple tooling. Using multiple tools meant that the barrel must be rigidly supported by steady rests while being turned. The Lo-swing method with carriages on the front which will pass the tailstock and the steady rests which, in turn, rigidly support the work seemed to be the best answer. As no Lo-swing large enough for this work had been built, the large Model "LS" Lo-swing was designed for the job. Nine tools were mounted on three carriages to turn the straight diameter tapers and contours simultaneously while three roll steady rests support the work. By this method the length of the longest cut was reduced to 32″ and the production on the turning operation was stepped up to one per hour.

To facilitate setup, the carriages can be rapid traversed either forward or backward independently or together. To make for easy chip disposal, the rear of the bed slopes down at a 20° angle.

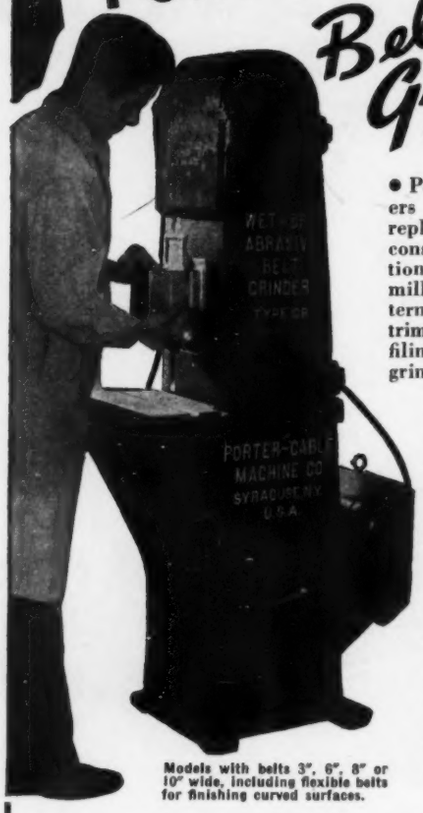
While a constant speed AC motor could be used for the main drive, a DC variable speed motor was used so that the most efficient cutting speed could be exactly and instantaneously obtained. The complete length of the barrels was turned in one operation, the work being driven from a slot in the muzzle end and expanding centers locating in the bore were used to maintain concentricity.

RELEASE & SUPPLEMENT

Other Equipment

BY USING

PORTER-CABLE Belt Grinders



Models with belts 3", 6", 8" or 10" wide, including flexible belts for finishing curved surfaces.

• Porter-Cable Belt Grinders (either Dry or Wet) replace or supplement, at considerable saving, operations normally done on millers, disc grinders, external broaching machines, trimming cutters, saws, filing machines, surface grinders, grinding wheels.

Here are some of the things you can do:

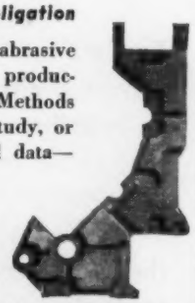
- True up register surfaces
- Remove burrs and flashings
- Finish bosses
- Level abutting surfaces
- Form radii
- Smooth edges for close fits
- Take off feed marks
- Square cut-offs

With a wet-belt you'll find Porter-Cable Grinders a big help on soft metals, plastics, rubber, ceramics, glass. Prevents heating, discoloring, fracturing, warping.

Let's Look at Your Job. . . .

No obligation

Porter-Cable extensive experience with abrasive machines in many lines is available to production men without charge. Write to Methods Engineer and send drawings for our study, or sample parts for tests and data—no obligation.



On these pieces a milling operation has been saved. Left: each face is belt ground to a true flat (no fixture needed) so that the two pieces fit together perfectly.

Above: One operation faces 12 bosses. Holds thickness within .005".

PORTER-CABLE MACHINE CO.

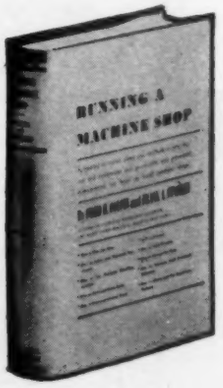
1725-3 N. Salina St. Syracuse, N. Y.

Is your shop ready for maximum production in National defense work?

How about *management?* Have you taken every means of improving your shop layout and handling of tools, work, records, men, etc., so as to eliminate bottlenecks and put through the greatest amount of profitable work in the busy days ahead? Here's a great new book by the famous machine-shop writers, Fred Colvin and Frank Stanley, in which owners and managers, foremen and shopmen can find practical means of straightening out all the intricacies of running a machine shop for maximum productiveness.

Just Published

Running a Machine Shop



By Fred Colvin, Editor Emeritus, *American Machinist,* and Frank Stanley, Editor, *Western Machinery and Steel World.* 403 pages, 6 x 9, 146 illustrations $3.50

HERE is the book to answer the questions that don't have to do with machine operations, yet that affect shop profits in many ways. How to set up and equip the shop, how to plan work, how to inspect and control it, where economies may be made, how production may be improved, how to keep records, how to manage men—these are the sort of important problems explained here on the basis of successful methods now in use.

Here are valuable pointers on:

—selecting machinery
—buying used machinery
—keeping machines in condition
—timesaving tool trucks
—moving work about the shop
—conveyors in the job shop
—toolroom layouts
—making the tool crib pay
—allocating machine hours
—shortening work travel
—estimating on contract work
—estimating from blueprints
—foremen's meetings
—farming out work
—planning for slack times
—modernizing a shop
—Where and when to inspect
—saving motions in assembly
—etc., etc.

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YOU'RE SURE OF PROFITABLE PRODUCTION

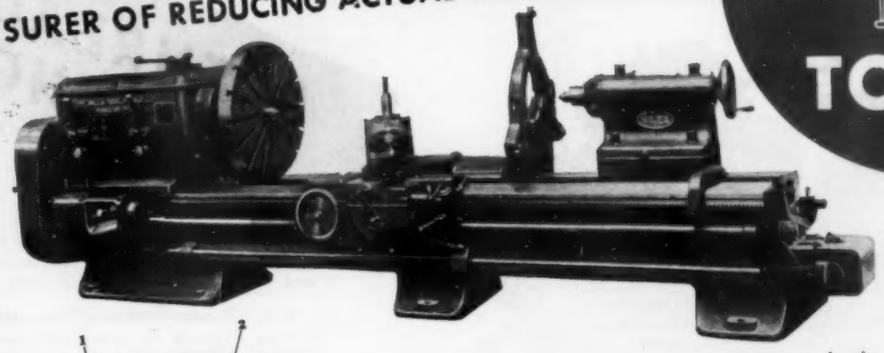
WHEN YOU SELECT

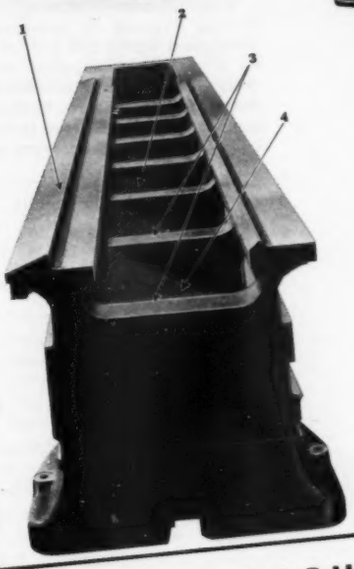
NILES "Time Saver" TOOLS

For Instance

THIS NEW NILES LATHE

IS SURER OF REDUCING ACTUAL TURNING TIME





True to its name, like all Niles products, this new member to the "Time-Saver" line has the driving power, strength and rigidity to promote faster production, as well as unusual conveniences of control and operation to speed the operator's every move. We illustrate below a few basic structural features that insure extra accuracy over longer years of heavy duty service. Other features, however, which also help this machine to contribute toward better quality, lower costs, and increased profits are: direct reading index plates; motor control at carriage; simplified feed control, etc. Is available in three sizes (27", 30", 36") and belongs in every shop where increased capacity and better work are important. Send for Circular 316-3 for detailed description.

LASTING ACCURACY BUILT INTO THE BED

The use of uniformly high quality metal, reduction of bearing pressure on ways, and extra protection against wear from chips and dirt assure lasting accuracy and permanent alignment. Other features illustrated opposite (in numerical order) include: Compensating Type V Bed Way; Solid Web Reinforced Bed; Double Wall Cross Ties; Sloping Web to carry chips to rear of machine.

LATHES • OPENSIDE PLANERS
BORING MILLS • ROTARY
MILLERS • DOUBLE HOUSING
PLANERS • DRUM MILLERS
RAILROAD TOOLS • RIFLING
MACHINES • GUN BORING
LATHES • PLATE PLANERS

GREATER PROFIT POWER IS A BUILT-IN FEATURE OF ALL NILES MACHINES

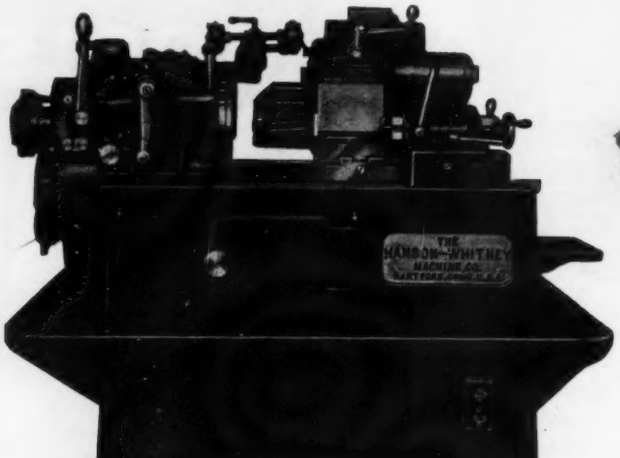
By combining ease of control, an extra margin of power, and unusual ruggedness, Niles is able to give you a line of machines with not only greater production capacity, but also a greater profit capacity. That's why we say "you're surer of profitable production when you select Niles 'Time-Saver' tools."

NILES

GENERAL MACHINERY CORPORATION
• NILES TOOL WORKS DIVISION •

HAMILTON • OHIO

HANSON-WHITNEY
TOOL ROOM ACCURACY



In THREAD MILLING

Hanson-Whitney has definitely solved the difficult problem of producing perfect threads to close limits and at low cost on a truly high production basis.

With Hanson-Whitney Threading Machines, the Milling Process is employed—an outstanding development which has proved its value in many shops as a means of stepping up thread production and at the same time maintaining high accuracy. These machines have also demonstrated their ability to successfully handle the threading of many materials ordinarily difficult to machine.

Semi-automatic in operation, with all functions except loading automatically controlled, H-W Thread Millers handle external or internal threading operations with equal facility as well as right or left hand threads. Taper threads can also be produced to the same high degree of accuracy as straight threads.

Complete detailed information is available in the H-W 16-page, fully illustrated bulletin, a copy of which will be sent promptly on request.

●

H-W 4x9 Universal, Semi-Automatic Thread Milling Machine—Capacities; external work up to 4" diameter; internal threading from ¾" to 4" diameter.

●

H-W 10x24 Universal, Semi-Automatic Thread Milling Machine. Capacities: external threading up to 10" diameter; internal milling of threads from 1" to 10" diameter.

HANSON-WHITNEY MACHINE CO.
HARTFORD

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MACHINERY ONLY — Philadelphia, Lloyd A. Arch, Inc.; Cleveland, William K. Stamets; Chi-

. . . . MAKES IT EASY TO GET with PRODUCTION SPEED

In TAPPING

Explore the possibilities of "HANSON-PROCESS" Taps as a means of assuring more tapped holes between grinds—holes that will pass closest inspection for accuracy in long, hard service.

There are sound reasons for the faster, more economical performance of H-W Taps. Close scrutiny will reveal the keen, sharp cutting edges of these modern, accurate, long-lived, high quality taps—advantages and features made possible by the "Hanson-Process" of final finishing *after hardening*.

This process is one which also involves strict control of *every* manufacturing operation. As a result, H-W Taps can always be depended on for correctness in lead, angle and diameter.

The economy of using "Hanson Process" Taps can easily be demonstrated. Go into your shop and select the tapping job that's causing you the most trouble or where your present tapping costs are too high. Tackle the job with an H-W Tap. Put it to every test. Note the speed with which it cuts and the quality and accuracy of the holes tapped. Compare results with the best you've heretofore attained and you'll be satisfied that "H-W Process" Taps are the answer to your problem of achieving more and better tapped hole production at big savings in time and money.

To standardize on H-W Taps is to cut costs on *all* tapping operations. Investigate NOW!

-WHITNEY
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[illegible], Marshall & Huschart Machinery Co.; Dayton, Gulfcoast-Elstad Machinery Co.; Cincinnati, Belmont-Elstad Machinery Co.

SMALL TOOLS ONLY — Philadelphia, General Tool Sales Co.; Cleveland, George A. Whalen; Chicago, H. Ray Pearson; Minneapolis, E. Willard Pennington; Dayton, George Langen, Jr.; Cincinnati, George Langen, Jr.

A century and a half ago Ben Franklin wrote these words. Today, in this war-torn world, Time is still too precious to squander—is our most potent ally.

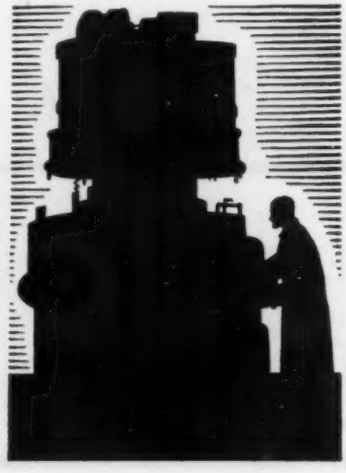
★ ★ ★

MACHINE TOOLS are the timekeepers on America's production lines. Without them Time and even Life, as America understands it, may be lost.

Bullard machine tools can be vital weapons in your fight to preserve Time. A specific example: It used to take 315 minutes or 5¼ hours to turn and drill the arms of an aeroplane propeller hub spider. A Bullard Type "D" Mult-Au-Matic now does it in approximately 25 minutes. Or, put it another way, 12 of these parts are now machined in the time it used to take to do a single one.

Perhaps you have Bullard Mult-Au-Matics or Vertical Turret Lathes now. If so, new Bullard tools and tooling layouts may help you to make them even more efficient. If you do not have our Standard Vertical Turret Lathe Tool Catalog, send for your copy today.

THE BULLARD COMPANY
Bridgeport Connecticut



BULLARD

more than a machine-

A METHOD

THE superiority of the continuous tooth Herringbone gear is not only well known but universally recognized for its greater strength and smoother action resulting from increased tooth contact.

Sixteen speeds and forty-eight changes of threads and feeds assure the maximum possibilities from all types of cutting tools. Anti-friction bearings on all units and parts subject to radial or thrust loads and Timken precision bearings on the spindle transmit smooth, silent power from the gearing to the work.

These are but a few of the modern construction features found in Sidney Lathes that account for their ability to maintain close tolerances on production jobs and costs that make for increased profits on all lathe operation.

Built in 14" to 36" capacities to cover a wide range of manufacturing applications.

The SIDNEY MACHINE TOOL Company
SIDNEY U.S.A. OHIO

HENDEY LATHES

IN THE TOOL ROOM OF THE SPRINGFIELD ARMORY

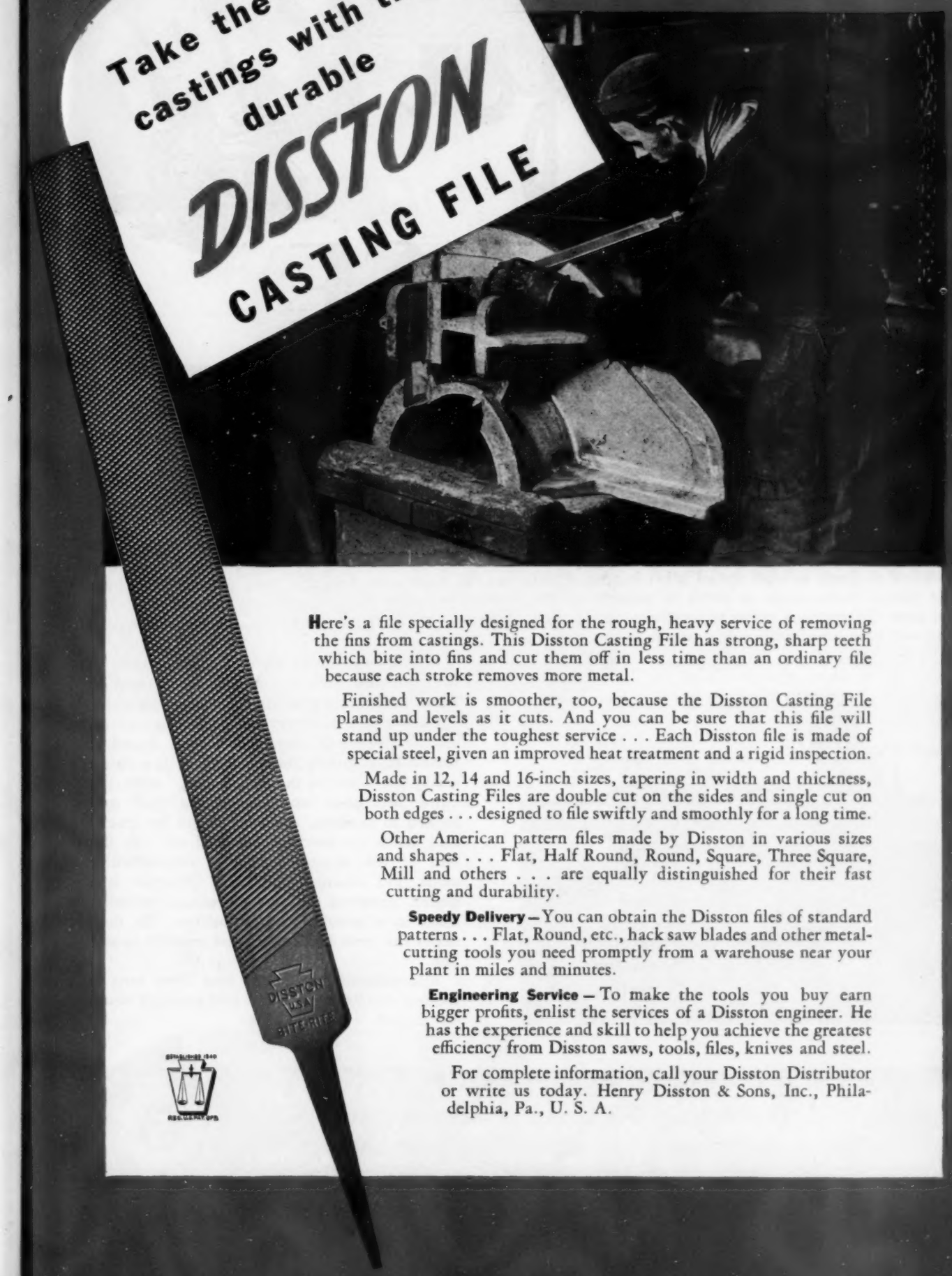
These 12" x 30" HENDEY PRECISION GEARED HEAD LATHES—are used in turning out the fine quality tool work for which Hendey machines have been universally known over a period of many years.

Regardless of the requirements—whether for tool room or production—for military, naval or industrial service—Hendey Lathes and Shapers can be depended on for more and better work at lower cost.

THE HENDEY MACHINE COMPANY
TORRINGTON, CONN., U. S. A.

BOSTON NEW YORK ROCHESTER DETROIT CHICAGO

Take the fins off castings with this durable DISSTON CASTING FILE



Here's a file specially designed for the rough, heavy service of removing the fins from castings. This Disston Casting File has strong, sharp teeth which bite into fins and cut them off in less time than an ordinary file because each stroke removes more metal.

Finished work is smoother, too, because the Disston Casting File planes and levels as it cuts. And you can be sure that this file will stand up under the toughest service . . . Each Disston file is made of special steel, given an improved heat treatment and a rigid inspection.

Made in 12, 14 and 16-inch sizes, tapering in width and thickness, Disston Casting Files are double cut on the sides and single cut on both edges . . . designed to file swiftly and smoothly for a long time.

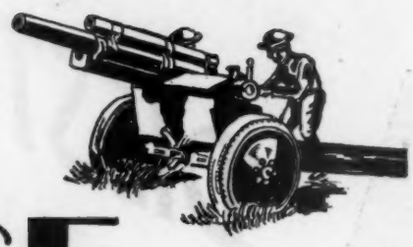
Other American pattern files made by Disston in various sizes and shapes . . . Flat, Half Round, Round, Square, Three Square, Mill and others . . . are equally distinguished for their fast cutting and durability.

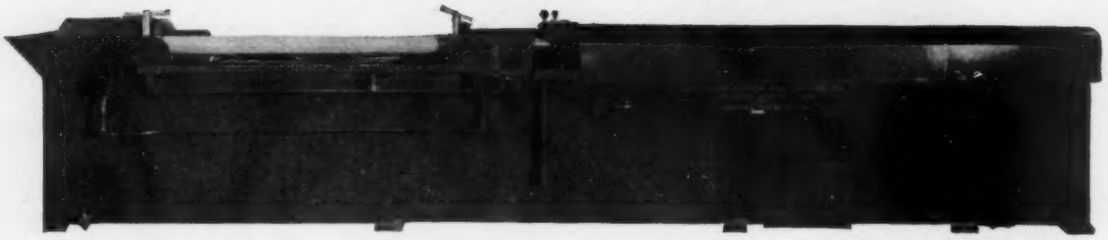
Speedy Delivery — You can obtain the Disston files of standard patterns . . . Flat, Round, etc., hack saw blades and other metal-cutting tools you need promptly from a warehouse near your plant in miles and minutes.

Engineering Service — To make the tools you buy earn bigger profits, enlist the services of a Disston engineer. He has the experience and skill to help you achieve the greatest efficiency from Disston saws, tools, files, knives and steel.

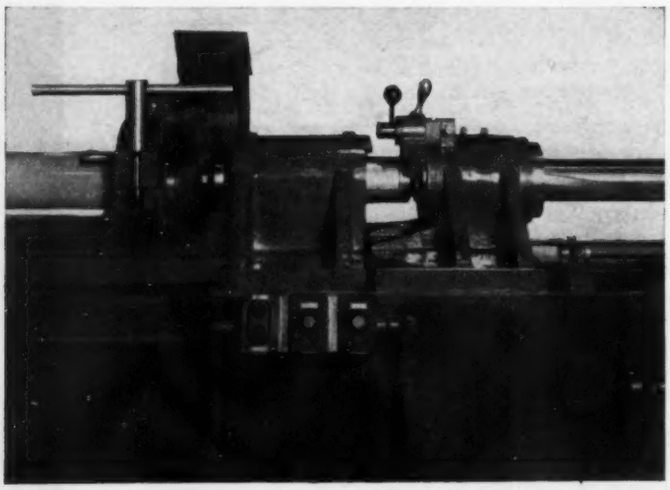
For complete information, call your Disston Distributor or write us today. Henry Disston & Sons, Inc., Philadelphia, Pa., U. S. A.

AMERICAN Speaks for DEFENSE





The AMERICAN Hydraulic Gun Rifling Machine is designed and built for broaching rifle grooves of constant helix in 105 MM Howitzer barrels. The method employed in producing the rifling grooves in gun barrells is to push a high speed steel hardened and ground cutter through the gun, driving the cutter in the proper helix angle in order to broach all the grooves together. Each cutter has an increased diameter over the previous cutter to facilitate taking a chip approximately .001 to .002. The cutter is mounted on the end of a long quill which guides in the bore of the gun barrel.



Photograph above shows the front view of the machine with all guards in place and sample tubing in position for rifling operation.

Photograph at lower left shows guard removed from lead bar and hinged guard is raised to illustrate the position of the cutter ready for entering the gun barrel. After the cutter has been mounted on the quill and locked in position, operator drops the guard and starts the machine through cut. At the end of the stroke, machine automatically stops and coolant shuts off. Operator lifts guard, removes cutter and returns machine back to original starting position. He then takes the next size cutter and repeats operation.

Approximate broaching time after part is loaded and lined up is one and one-half hours per barrel.

AMERICAN BROACH & MACHINE COMPANY
ANN ARBOR, MICHIGAN, U. S. A.
BROACHING MACHINES, PRESSES, BROACHING TOOLS, SPECIAL MACHINERY

Division of SUNDSTRAND MACHINE TOOL CO. ROCKFORD, ILLINOIS, U.S.A.

1941

8 inch COLD METAL SAWING MACHINE

Steps Up PRODUCTION

This new machine—with a capacity up to 8 inch round and 7½ inch square—provides speed, power and easy handling. By means of a special holding fixture, multiple cutting can be handled up to the capacity of the machine. Bars or shapes can be "nested" in economical quantities and adequately supported for cutting on sides and bottom.

Features of design which invite close attention include:

. . . upward feed of blade to stock by which riding and bumping are prevented.

. . . friction disc feed which insures against blade breakage.

. . . pulling of blade through cut from in front and below on a diameter well out from the center of the blade—a construction that eliminates weaving and buckling.

. . . stability of blade support is assured by swing frame fulcruming on heavy bronze bushing held rigidly in the main frame and trunnioned in large outboard bearing.

. . . simple and easy adjustment of blade support makes it possible to use blades of different thickness to suit requirements of specific jobs.

. . . Standard feed is 0 to 3" a minute—this can be stepped up for brass and non-ferrous metals.

Write today for Descriptive Bulletin

MACHINE TOOL COMPANY

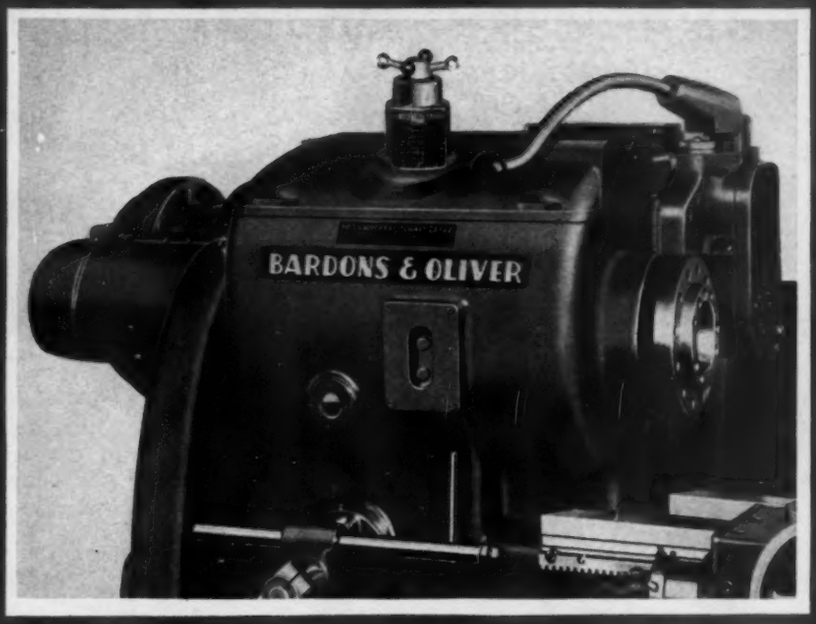
MACKLIN
Grinding Wheels

TO PREPARE our country for defense, quality tools are in great demand . . . . Macklin grinding wheels are quality wheels, manufactured to give longer life, cooler and faster cutting, and show cost saving results. They are made in all grain and grade combinations for all types of grinding jobs . . . To protect your country, "Protect Your Production" with Macklin grinding wheels.

Ask for the services of a Macklin Sales Engineer who will, without obligation, assist you with your grinding problems.

MACKLIN COMPANY
Manufacturers of Grinding Wheels
JACKSON MICHIGAN

Bardons & Oliver

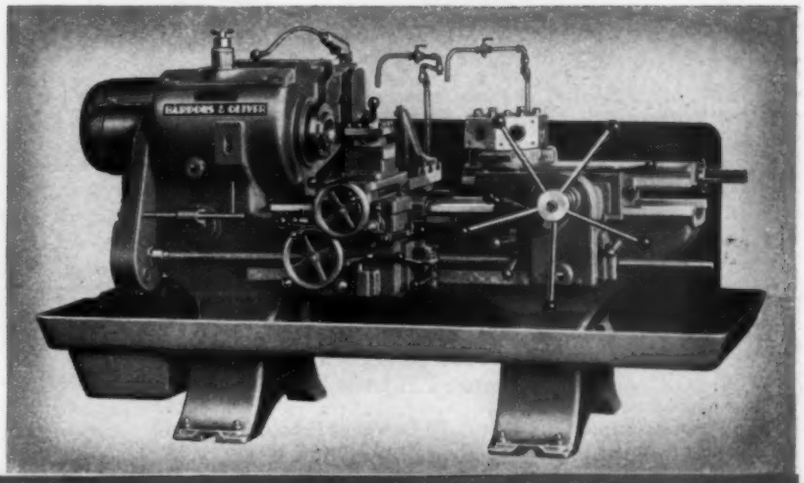


Ease of control increases production

OUR HYDRAULIC SPINDLE SPEED PRE-SELECTOR is the easiest and quickest speed changing control used in turret lathe design.

Continuing improvement in cutting tools calls for higher cutting speed and more rapid, convenient and easy control of speed changes to realize the maximum production obtainable.

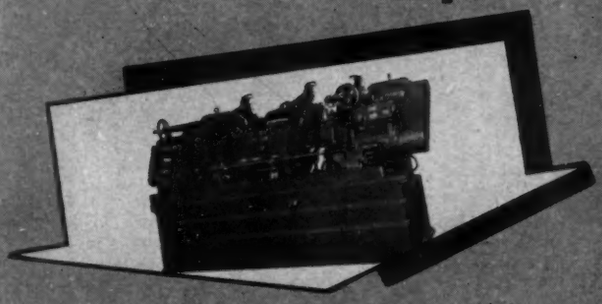
Operating time is saved by pre-selecting the spindle speed for the second cut while the machine is still working on the first. A short, natural, easy motion of the single control lever and the new spindle speed is obtained.



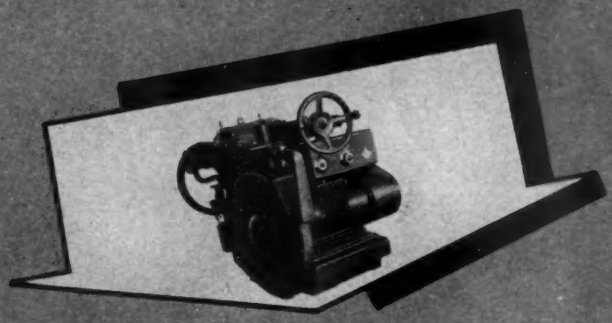
BARDONS & OLIVER, INC.
1133 W. 9th STREET • CLEVELAND, OHIO
We build a complete line of ram type turret lathes.

FITCHBURG

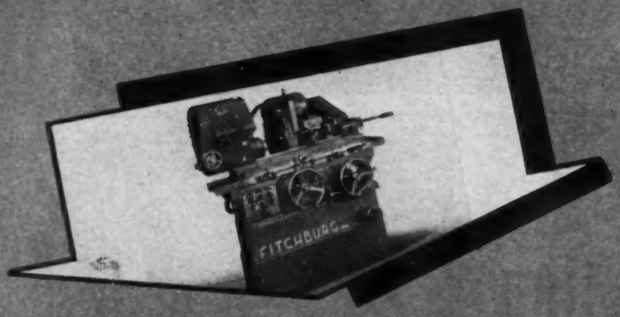
shows the way to cut GRINDING COSTS



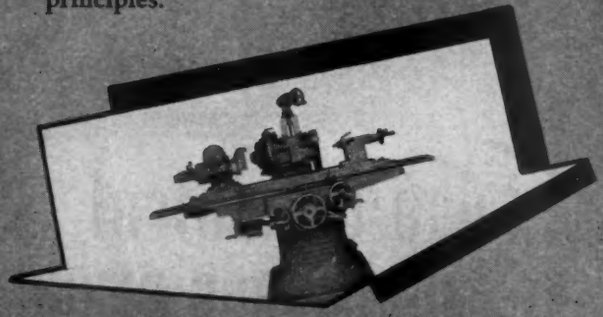
On Mass Production Work: With Automatic Multiple precision grinding with special machines like these using standard Bowgage Wheelhead units.



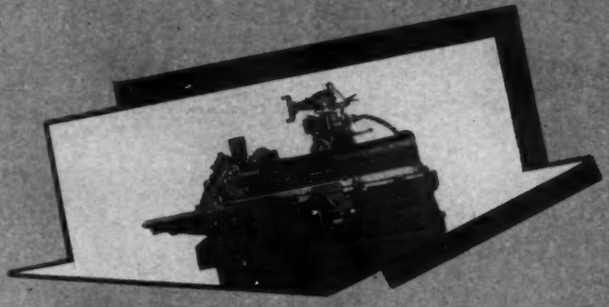
On High Speed Work: Bowgage Wheelhead units like this can be mounted on your present machines to increase production and accuracy control by a new application of accepted mechanical principles.



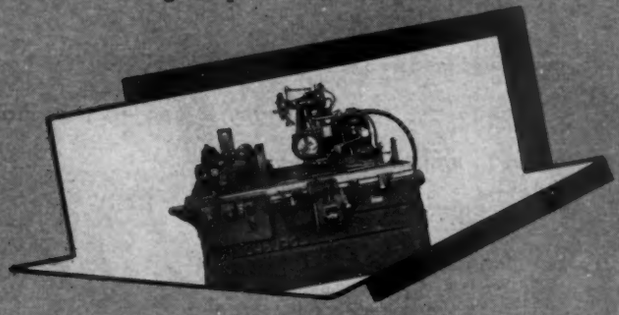
On Plain Cylindrical Work: By cutting out costly frills not needed on normal work and standardizing on low cost, rigidly accurate, long-lived Fitchburg Grinders. They cost less to start with, save money as you use them.



On Tool Room and Small Lot Work: With Bath fully universal grinders, easily and quickly adaptable to external, internal, surface, gear cutter and tool grinding. With this one machine you can do a wide range of precision work.



On Splines: Greater accuracy at higher speed saves on assembly time, evens torque pressures and produces finishes that wear better on sliding splines, to cut costs and boost profits.



On Gear Grinding: The formed wheel method with an automatic closed cycle produces results in finish and accuracy with speed that will bring out hidden profits.

FITCHBURG GRINDING MACHINE CORP.

1701 WALNUT STREET, FITCHBURG, MASS., U.S.A.

Without obligation you may send us latest literature on machines checked:

- ☐ Special Multiple Grinding Equipment
- ☐ Fitchburg Type A Cylindrical Grinders
- ☐ Bowgage Precision Wheelhead Units
- ☐ Bath Universal Precision Grinders

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MUNITIONS MANUFACTURERS

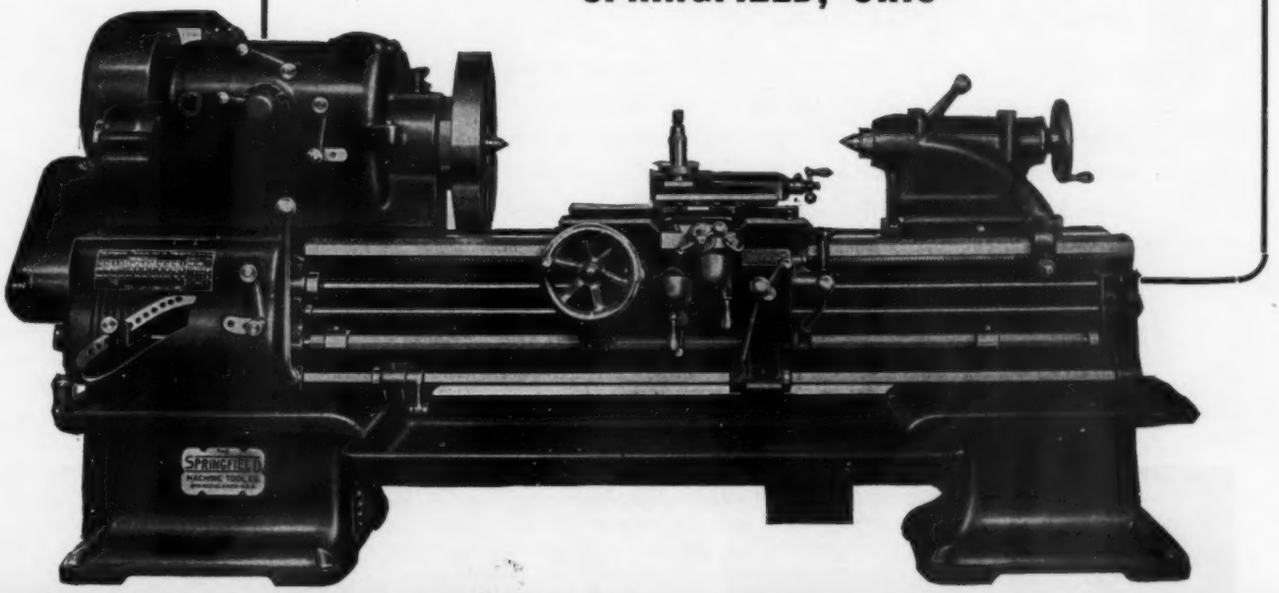
...LOOK TO SPRINGFIELD PRECISION LATHES!

. . . here is a lathe which is truly modern from headstock to tailstock. Features which are especially timely mark it as an outstanding value for both tool room and quantity production use. Primary among these features—one that assures accuracy, and therefore is of great importance to munitions manufacturers—is MATERIALS.

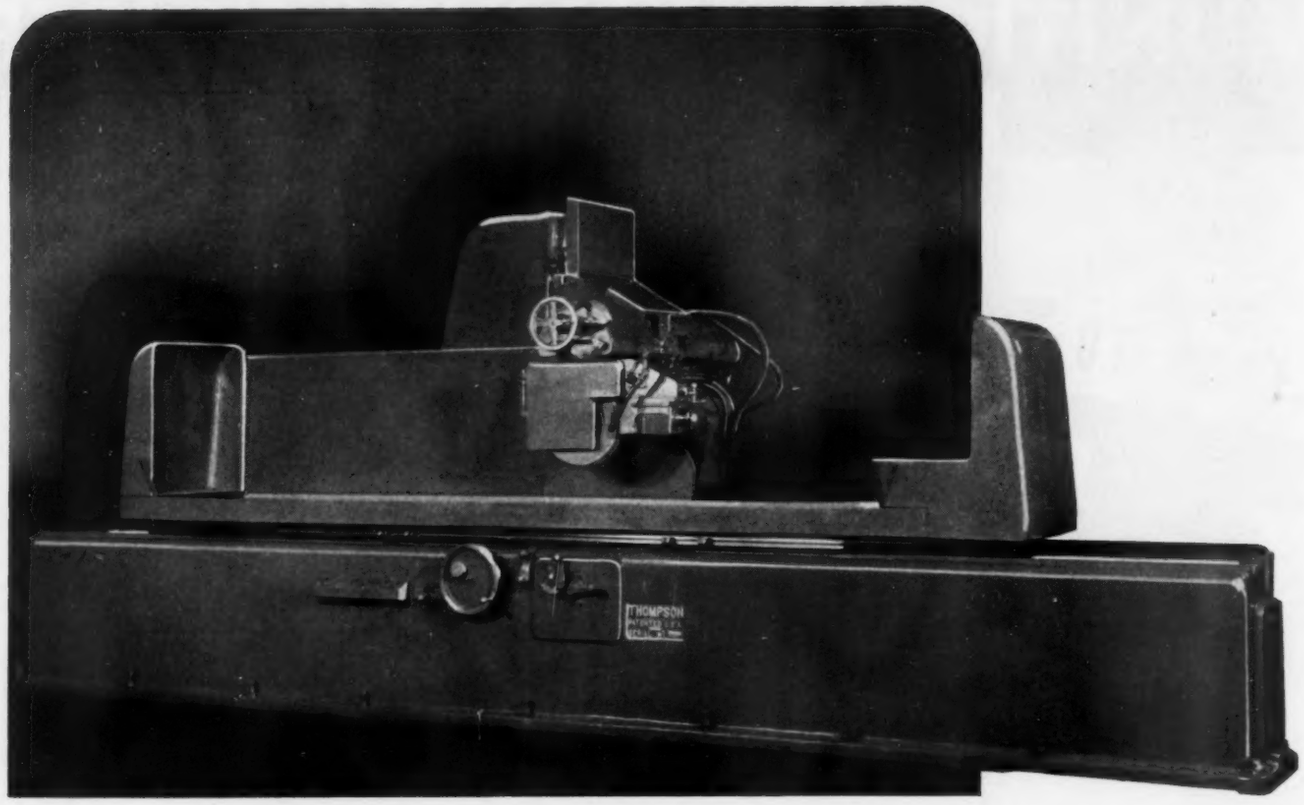
Springfield Lathe beds are made in our own foundry—of highest nickel-chrome gray iron—an operation that enables us to *guarantee* strength and wear-resisting qualities . . . allows us to follow through on each casting operation . . . makes *certain* every rigid standard we specify. Springfield iron itself, too, is especially resistant to warping and marring, even under severest service. Here, then, are factors that account for the sustaining, over long periods of use, of the original accuracies built into every Springfield Lathe.

The SPRINGFIELD **MACHINE TOOL** *Co.*

SPRINGFIELD, OHIO



Retooling, especially for munitions manufacturers, should take into consideration (1) extreme ACCURACY and (2) maintenance of such accuracy. In other words, LONG LIFE. And the Springfield Lathe delivers both!



Now—you can grind MACHINE WAYS *on*

THOMPSON PRECISION GRINDER

This Thompson Precision Grinder was designed and built to grind bed ways for a well known machine tool builder. Its success on this operation recommends it most highly for grinding machine ways for other manufacturers of machine tools or for finishing surfaces on any equipment ordinarily requiring hand scraping.

Vibrationless hydraulic power . . . massive construction throughout . . . wide range of feeds and speeds . . . centralized control are all features of Thompson Precision Grinders that make for accuracy and speed in grinding. Another unique point of construction in the machine shown is the electric truing device for dressing Vee shaped wheels.

Hand scraping has always been a slow tedious operation requiring skilled help and today trained scrapers are hard to find. Thompson offers in this Way Grinder a machine of proved ability and speedier operation.

Consult Thompson for modern, lower cost finishing operations.

(Above)
THOMPSON
20x24x120
Way Grinder
One of a complete line of precision grinding machines for high speed, accurate, grinding

VIBRATIONLESS HYDRAULIC POWER • WHEEL HEAD SLIDE WIPERS • HYDRAULIC RAPID TRAVERSE • GENEROUS COLUMN WAYS • POWER ELEVATION • TELESCOPE PIPING • PATENTED CONTROLS • ANTI-FRICTION ELEVATING NUT • VIBRATIONLESS WHEEL HEAD • ALLOY STEEL, HEAT TREATED SPINDLE • RIGID MACHINE BEDS • AUTOMATIC WHEEL TRUING • AUTOMATIC DOWN FEED • AUTOMATIC SPARK-OUT

THE THOMPSON GRINDER COMPANY, Springfield, Ohio, U. S. A.

Where will you be 5 years from today?

. . . Probably right where you are now, doing what you are doing now, but doing it better and faster, IF the new machinery you are ordering includes Axelson Lathes.

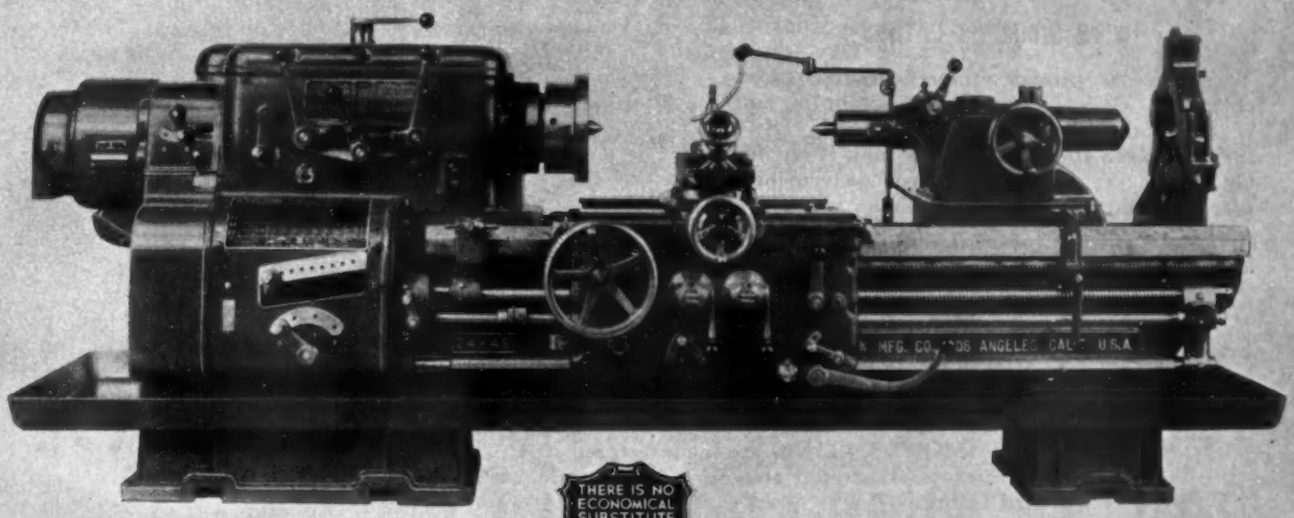
Now is the time for horse sense—not hysteria. Don't buy for this year alone but with the thought that the lathe you install today to machine munitions of war will ultimately be used for the tasks associated with peacetime manufacturing.

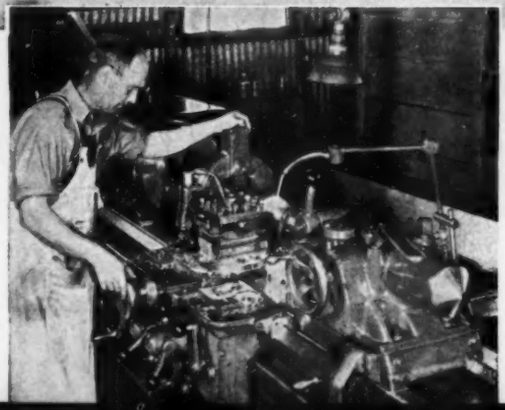
Axelson Lathes are designed right and they are built throughout of materials best adapted to the purpose. They are good today and we know that they'll still be doing a first-class job for their purchasers for many years to come. They afford a wide range of operating speeds and feeds necessary for fast production. They are accurate and they operate smoothly year after year with minimum power consumption.

Before you buy any lathe investigate Axelson

AXELSON MANUFACTURING COMPANY

6160 South Boyle Avenue, Los Angeles, California (P. O. Box 98, Vernon Station) • 50 Church Street, New York • 3844 Walsh Street, St. Louis





At the left an Axelson Lathe is shown turning a half-inch taper on the end of a piston rod. This job requires accuracy to .001 of an inch.

The lathe illustrated above is an Axelson 24". Axelson Heavy Duty Lathes are also available in 14", 16", 18", 20" and 32" sizes.

WRITE TODAY for your copies of the newest Axelson Lathe Folders. Latest views of the lathes together with complete descriptions and specifications are given.

GIVE YOUR PRODUCTION *MICRO*-SPEED!

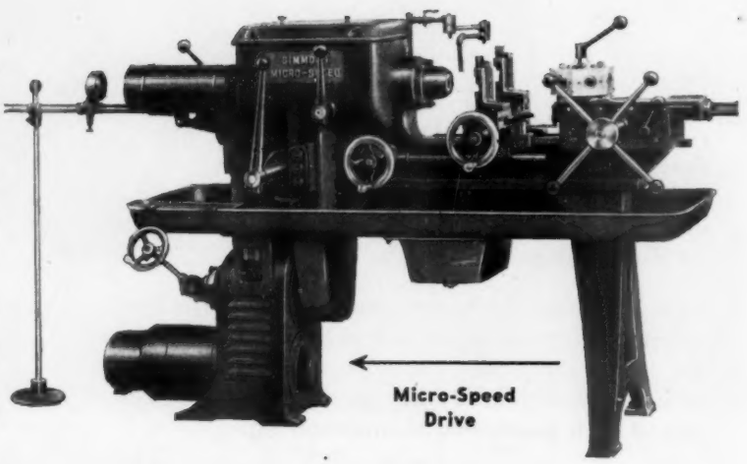
WITH SIMMONS TURRET LATHES

The nation's leading aircraft manufacturers, among other users of this sturdy machine, are outspoken in their praise of its high-precision performance.

It has been designed with the greatest simplicity. Production tooling equipment, adaptable to other standard turret lathes of similar size is also applicable to the Simmons machine.

THE SIMMONS MICRO-SPEED DRIVE, equipped with push-button control and magnetic brake, offers a range of spindle speeds *up to 1,500 RPM by a mere turn of a handwheel.*

Excellent delivery schedules.

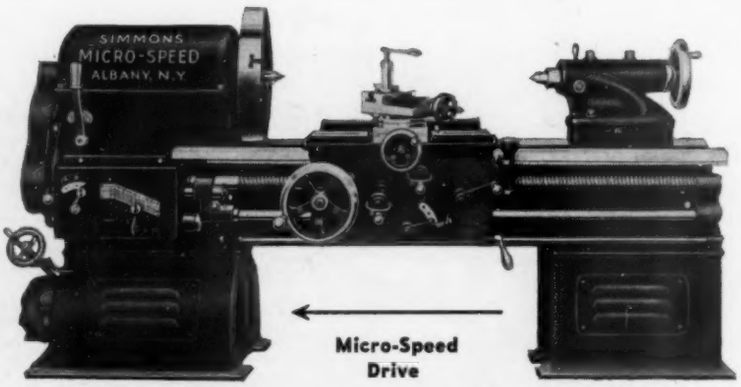


▲PLAIN OR BACK-GEARED. Spindles mounted on Timken Precision Tapered Roller Bearings. Levers within immediate reach of operators. Head cast solid with bed, insuring rigidity.

WITH SIMMONS LATHES

These lathes provides more spindle speed changes than it is possible to obtain in any geared-head lathe now manufactured. *Any speed* between the high and low limit is obtainable by operating a handwheel conveniently placed on the front of the machine.

In all other respects, the Simmons Lathes are of conventional design and include Timken Precision Tapered Roller Bearings, snap levers for apron feeds and added efficiency under heavy loads.



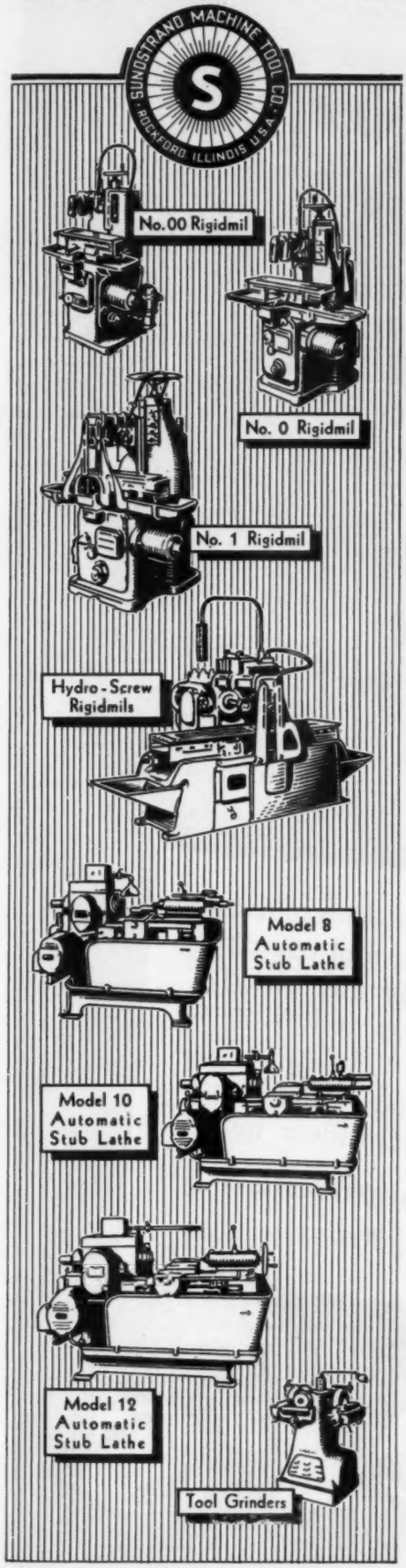
▲SIMMONS LATHES are manufactured in 16″ and 18″ standard; 18″ and 20″ heavy (illustrated above) and in a wide variety of gap bed sizes in all bed lengths.

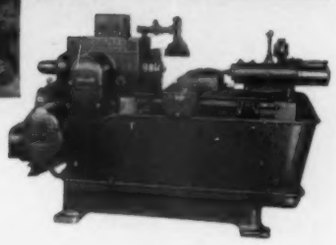
Write TODAY for Descriptive Bulletins

SIMMONS

MACHINE TOOL CORP.
1759 NORTH BROADWAY
ALBANY, N. Y.

Sundstrand *Works* For Peace





Automatic Stub Lathe Turns 1000 Different Bushings

The Automatic Stub Lathe illustrated turns, faces, and bores 1000 different sizes and types of bushings. Easy to set up and change over, it improved production wonderfully immediately after installation.

Other Automatic Stub Lathes are equally successful on thousands of different work-pieces handled in small, medium, or large lots on a high-production basis.

The features and advantages of Automatic Stub Lathes . . . and other Sundstrand machine tools . . . that produce profits in commercial service, also work for peace by increasing output, saving labor, and speeding completion of defense equipment.

Our organization is working at top speed, plant capacity scheduled in advance. Nevertheless, our Engineered Production Department is always available for developing applications of Sundstrand machine tools to commercial service or defense equipment manufacture.

Booklet shown above tells why Sundstrand Automatic Stub Lathes are so easily set up, so highly productive, durable, and economical. Pictures, diagrams and specification tables make it easy to read quickly. Get your copy today. Write for Bulletin 391.

Sundstrand Machine Tool Co.
2533 Eleventh Street, Rockford, Illinois, U. S. A.

RIGIDMILS • STUB LATHES

Hydraulic Operating Equipment — Centering Machines — Tool Grinders

Every member of our organization gladly makes this vow:

"I pledge allegiance to the Flag of the United States of America and to the Republic for which it stands, one Nation indivisible, with liberty and justice for all."

SELLERS Duplicate Tool Grinding SAVES TIME—is more ACCURATE

Manufacturers are saving many valuable man-minutes with Sellers automatic method of *duplicate* tool grinding which produces and reproduces practically any straight or curvex form to exact specifications by following a template cam.

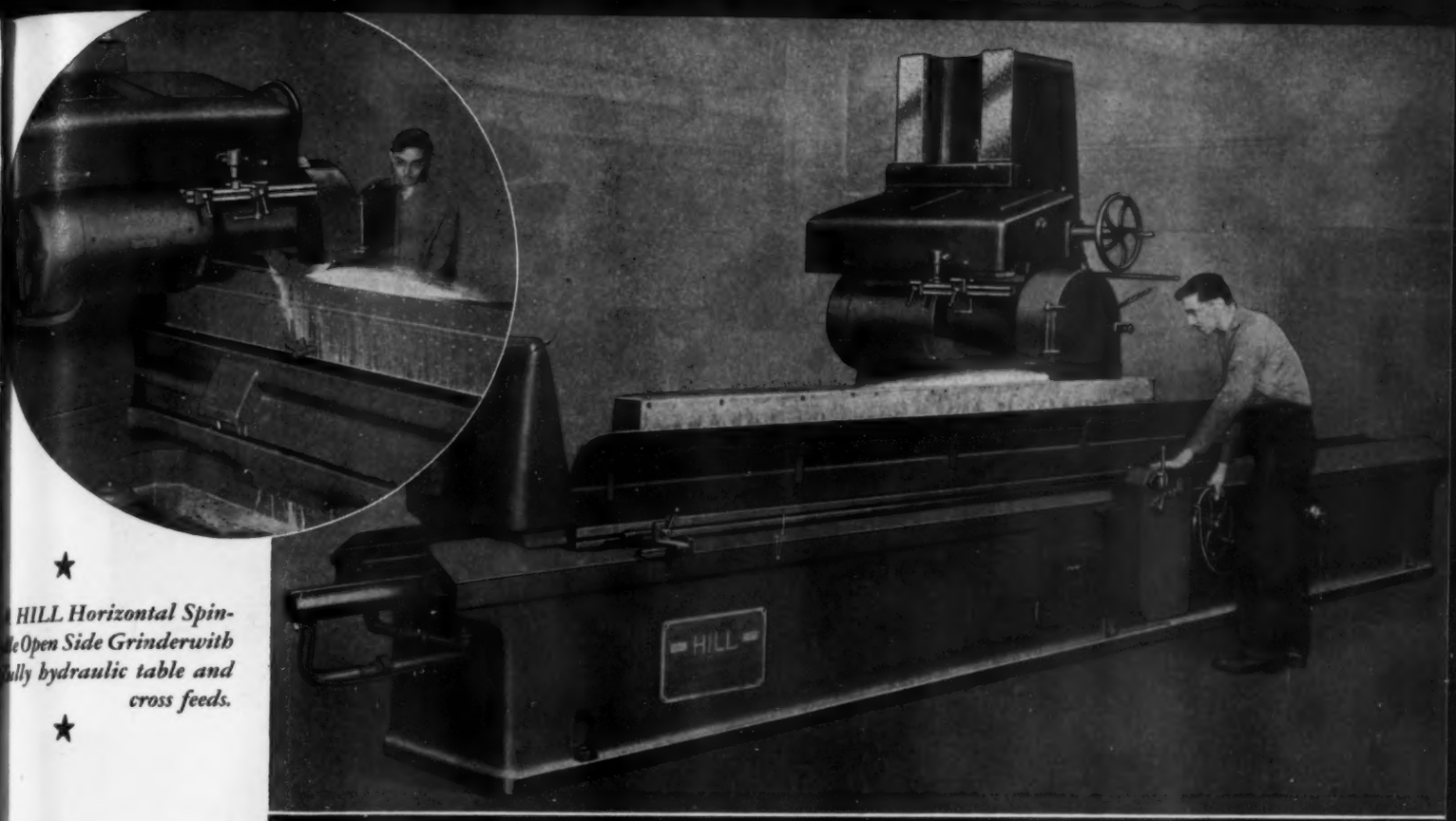
If you want to save time in tool grinding — and lower tool costs too — investigate Sellers Tool Grinders today.

William Sellers & Co., Incorporated

1610 Hamilton St., Phila., Pa.

FOUNDED SELLERS 1848

Sellers



A HILL Horizontal Spindle Open Side Grinderwith fully hydraulic table and cross feeds.

It HAD To Be Good To Get THIS Acceptance

Recent purchasers of HILL *Open Side* Hydraulic Surface Grinders, include the Aircraft Industry, Railroads, Steel Mills, Machine Tool Builders and general Industrial Plants.

Owners of HILL Hydraulic Precision Surface Grinders are enthusiastic about the new and varied uses for these versatile machines. You may purchase a HILL Grinder for a specific job, but actually you will find ever widening applications that effect savings in production costs.

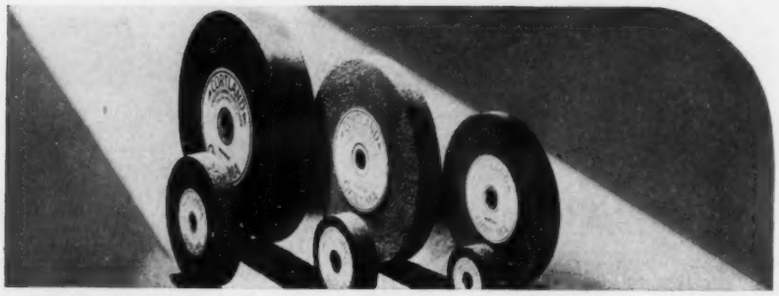
These HILL Grinders have more power than you'll ever need,— more smoothness of operation than you ever thought possible,— and above all, PERMANENT ACCURACY, because of the simplicity and ruggedness of design.

HILL *Open Side* grinders are built in table widths as follows: HORIZONTAL TYPE 18", 24", 30" and 36". VERTICAL TYPE 18", 24" and 30." Table lengths range from 5 to 20 feet.

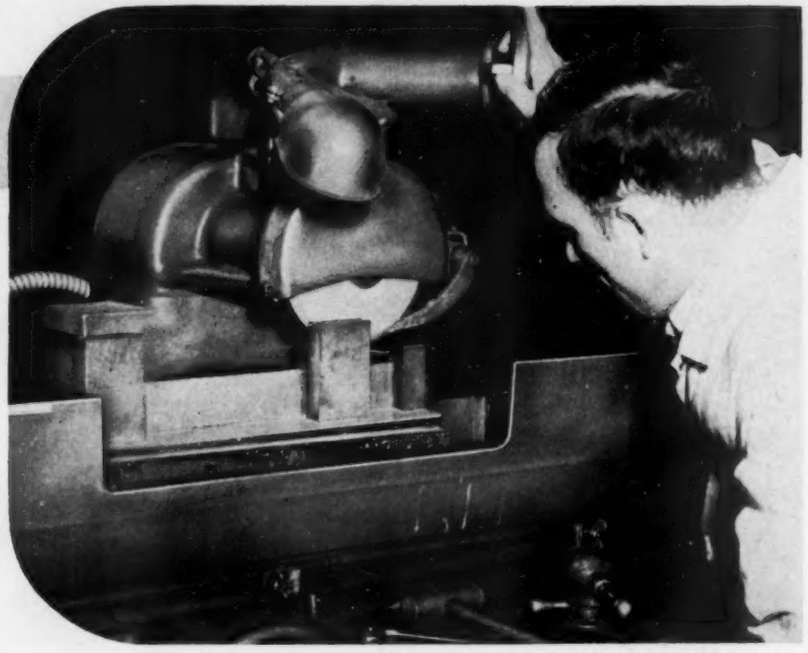
Write today for complete descriptive information — no obligation!

The HILL ACME CO.

A consolidation of two nationally known, fifty year old manufacturers:—The Hill Clutch Machine & Foundry Company... and The Acme Machinery Company
6400 BREAKWATER AVE., CLEVELAND, OHIO



CORTLAND IMPROVED GRINDING WHEELS



HANDLE MANY EXACTING TOOL ROOM GRINDING REQUIREMENTS FOR THE WHITIN MACHINE WORKS • • •

Improved Cortland Wheels are assuring high quality performance on a variety of tool room jobs for the Whitin Machine Works, Whitinsville, Mass.

The operation shown is performed with an 8 x ¾ x 1¼ H 46-G CORTLAND "H" Oxaluma Vitrified wheel on a 6 x 18 Wet Surface Grinder. Parts are V blocks for jig assembly—material is S.A.E. 1020 hardened and ground. Specifications call for commercial finish with block to be perfectly true and in line. Since Cortland Wheels have been used on this operation, production has been stepped up 20%.

Many other tool room requirements in this shop are being handled with Cortland Wheels, such as grinding form tools, dies, broaches and similar work.

Such acceptance is indicative of the high quality service being rendered by these improved wheels. This service, in turn, is the result of the care taken to control every step in manufacturing to insure better, faster cutting wheels that can be depended on for uniformity—wheels that will be right for the work intended.

Try Cortland Wheels—give them an opportunity to prove their greater value.

Wheels • • •

FOR EVERY GRINDING JOB

OXALUMA WHEELS

Durable, economical, high production grinding wheels made with Oxaluma, an abrasive produced in electric furnaces to insure maximum hardness, sharpness and toughness. Recommended for grinding metals of high tensile strength.

"H" OXALUMA WHEELS

Made from a highly refined crystalline aluminum oxide electric furnace abrasive developed to produce fast, cool cutting qualities for precision grinding operations. Recommended particularly for surface grinding of high speed steel and other operations where a high degree of accuracy is essential.

CARBORA WHEELS

For grinding materials of low tensile strength such as cast iron, brass, bronze and non-metallic materials, made from Carbora, a crystalline silicon carbide abrasive, a product of the resistance type electric furnace.

CORTLAND GRINDING WHEELS CORP.
Chester, Mass.

GRAND RAPIDS

Hydraulic feed SURFACE GRINDERS

. . . *for 1941's* URGENT, EXACTING NEEDS

MODEL "F"
PRODUCTION TYPE

These modern "Grand Rapids" units provide every feature for maintaining high accuracy under maximum production requirements. They are 1941 machines for 1941 demands in productive capacity.

Developed from more than thirty-five years specialized experience, they combine ruggedness in construction with smooth, long-lived accurate performance. Every convenience is provided to assure speed and easy handling.

"Grand Rapids" Surface Grinders are available in sizes and types to meet every 1941 requirement. Complete detailed specifications are available on request. Consult "Grand Rapids" on your surface grinding problem and be assured that our recommendations will exactly fit your needs.

CONDENSED SPECIFICATIONS

MODEL A CROSS TRAVELING HEAD HYDRAULIC FEED SURFACE GRINDER—PRODUCTION TYPE— Built in following sizes: 12"x36"; 12"x48"; 12"x60"; 12"x72"; 14"x36"; 14"x48"; 14"x60"; 14"x72".

Ask for Bulletin GL No. 115 giving full details.

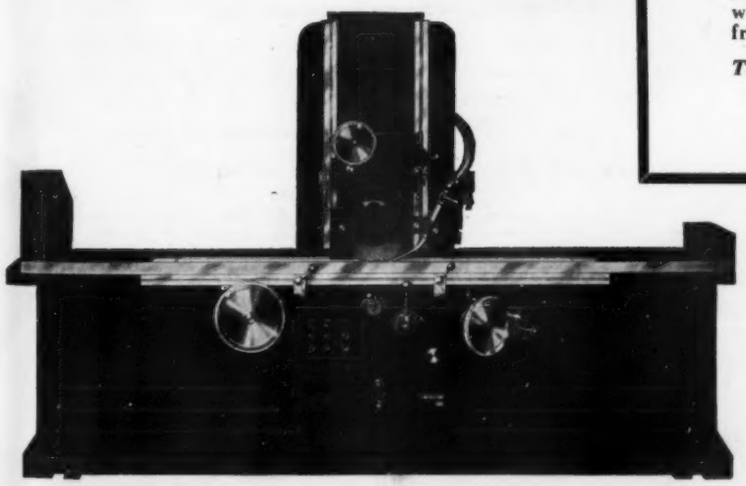
HIGH SPEED HYDRAULIC FEED SURFACE GRINDER PRECISION TYPE. Built in following models and automatic longitudinal table travels.

No. 25-20"; No. 28-26"; No. 35-36"; No. 38-38"; No. 45-26"; No. 55-38"; No. 65-50".

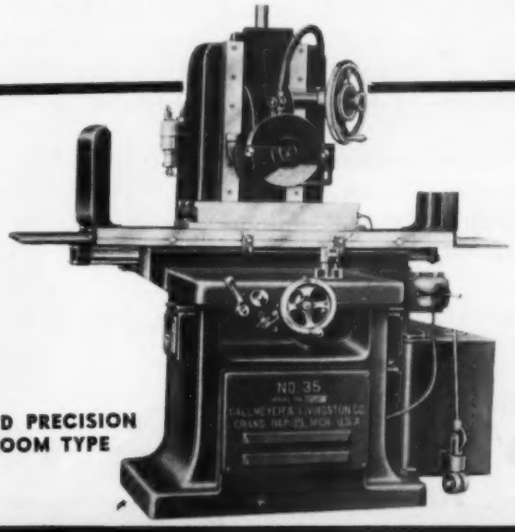
Ask for Bulletin GL 100 giving detailed specifications.

MODEL "F" CROSS TRAVELING HEAD TYPE SURFACE GRINDER — PRODUCTION TYPE — Obtainable with 12", 14", 16", 18", 20" widths of table and in lengths from 36" to 72".

These machines are fully described in Bulletin GL 108.



MODEL "A"
PRODUCTION TYPE

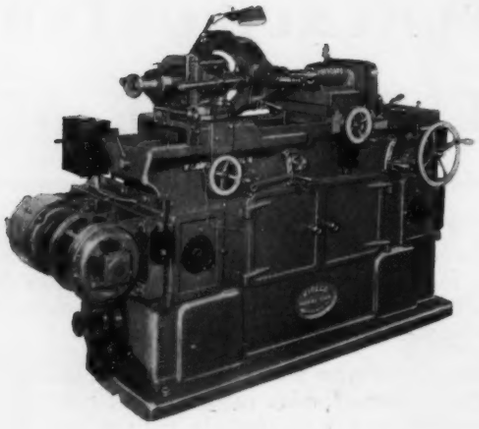


HIGH SPEED PRECISION
TOOL ROOM TYPE

GALLMEYER & LIVINGSTON CO.

330 STRAIGHT AVE. S.W.

GRAND RAPIDS, MICHIGAN



A Tool-room Necessity

THE WICACO PRECISION INTERNAL GRINDER . . . AIRCRAFT AND AUTOMOBILE motor manufacturers in particular find THE WICACO GRINDER very flexible and that it adds profitably to their tool room and production operations because it assures extreme accuracy and years of trouble-free performance.

For over 15 years, these accurate machines have been economically producing for us work requiring extremely close tolerances. While minor improvements on the more recent models have been made it is the same machine that has given us exacting and faultless service . . . Features include Vibrationless Underslung Drive; Rigid Work-Head; Automatic Carriage Reverse; Carriage Stops graduated to .001.

Model illustrated is equipped with motor-generator (Extra Equip.) for D. C. operation. Shipped ready to hook up to current and operate.

Write today for complete details

The
WICACO MACHINE CORP.
Est. 1868... Our 73rd Anniversary
Stenton Ave. & Louden St.
Wayne Junction Philadelphia, Pa.

Clover Products

MUST MEASURE UP

to This Mark of Clover Quality

Why do Clover Coated Abrasives lead in cutting power, give longer sanding life and provide lower production costs? Because, throughout the process of manufacture, every element—backing, abrasive grain and glue—as well as the finished product, is under the alert scrutiny of Clover chemists and engineers.

Nothing is left to chance. Every precaution is so exercised that each Clover ingredient and each finished Clover product measure up to the Clover standard of quality.

COATED ABRASIVES AT THE RIGHT PRICES FOR YOUR EVERY SANDING NEED

If your distributor cannot supply you, write us direct. Also ask us for informative Abrasive Manual, and for free working sample offer. Address DEPT. H.

CLOVER MFG. CO., NORWALK, CONNECTICUT

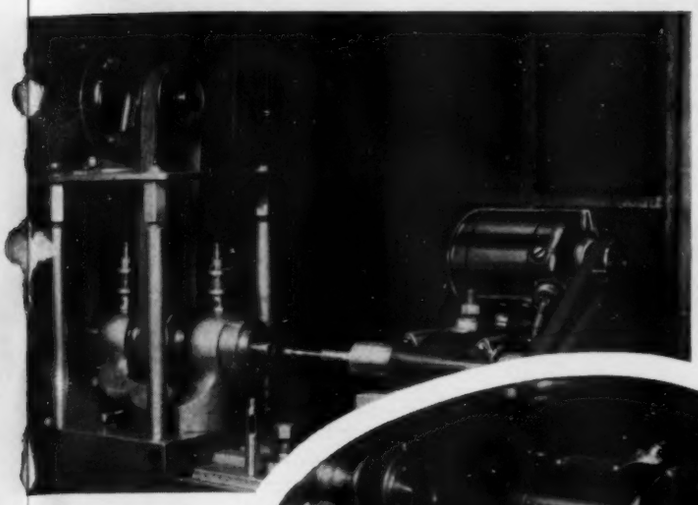
ASK, ALSO, ABOUT CLOVER GRINDING AND LAPPING COMPOUND — FAMOUS FOR 38 YEARS

In the 38 years Clover Compound has been the first choice of expert machinists for precision lapping, over 40 million cans have been used,—each can demonstrating these long-famous Clover qualities • Perfectly graded, super-sharp, diamond-hard Silicon Carbide grain • Eight grades from microscopic fine to very coarse • Special heat-resisting petroleum hard oil binder • Withstands friction temperatures • Maintains uniform consistency and grain suspension • Fast-cutting • Cool-cutting • Does not burn work.

CLOVER
Coated Abrasives
Easily Identified by Color-Striping and the Famous Clover Trade Mark

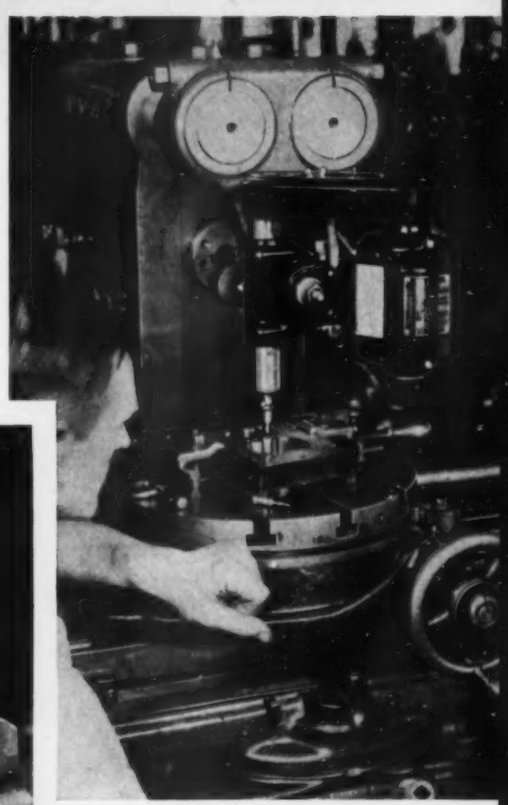
QUALITY ABRASIVES SINCE 1903

Accuracy in Action!



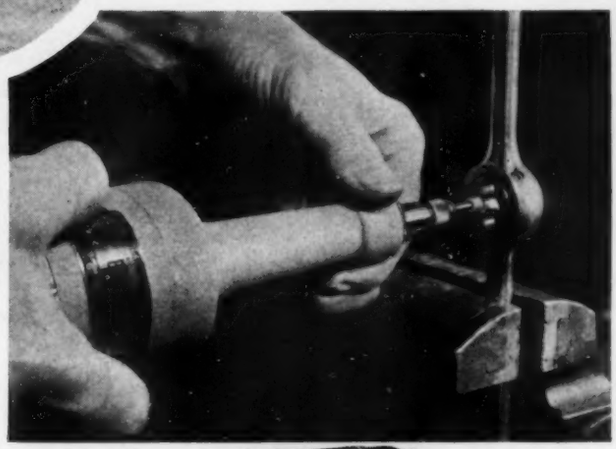
ally-Jones and Co., ◆ icago, well-known nufacturers of tools, upon the versatile more No. 5 to pro- e .0001" accuracy a gruelling produc- n job.

◆ Agriculture is as old as time, but the methods employed today are the product of Twentieth Century ingenuity. Dumore is proud of the part their precision Grinders have played in the development of modern tractor power.

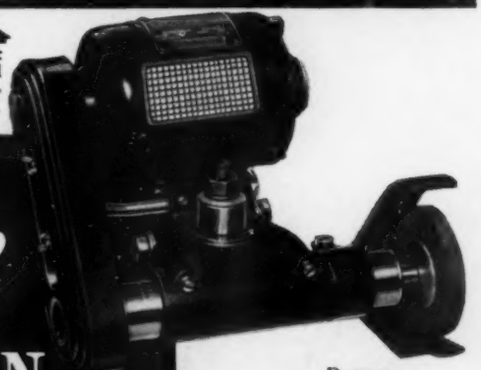


◆ Accurate tools and dies are essential in making fine watches. Here's another Dumore No. 5 at work in the plant of the Hamilton Watch Co., Lancaster, Pa.

◆ The New Departure Division of General Motors Corp., has done much to revive the popularity of bicycling with better bearings and breaks. Dumore grinders will be found in their plants (and, by the way, New Departure bearings will be found in Dumore grinding quills).



◆ Here a Dumore No. 5 mounted on the head of a miller, is doing one of 57 operations on an exacting motor lamination die . . . a typical Dumore precision job.



◆ Touching up a button die is ordinarily a "tricky" task, but a vibrationless, high-speed Dumore No. 10 Hand Grinder makes it a quick, easy job.

Dumore No. 5 "Master"

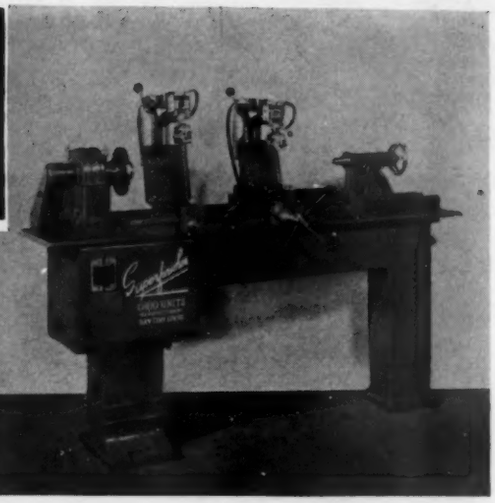
Dumore PRECISION Grinders

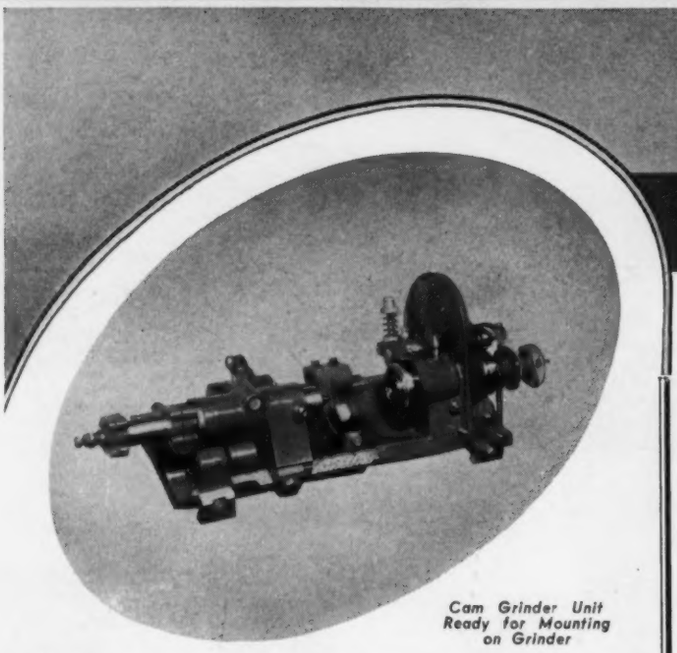
Precision grinding reaches greater importance every day as the demand for accuracy in industry becomes greater. Originally introduced as a tool and die room accessory 25 years ago, Dumore grinders, because of their wide versatility, have been drafted into use on production lines where they assure a better product while reducing labor costs, overhead charges and spoilage. There's a Dumore industrial distributor near you who will give you full facts . . . without obligation.

THE DUMORE COMPANY • Dept. 131-C • RACINE, WISCONSIN

OHIO UNITS *Superfinisher*

LICENSED BY CHRYSLER



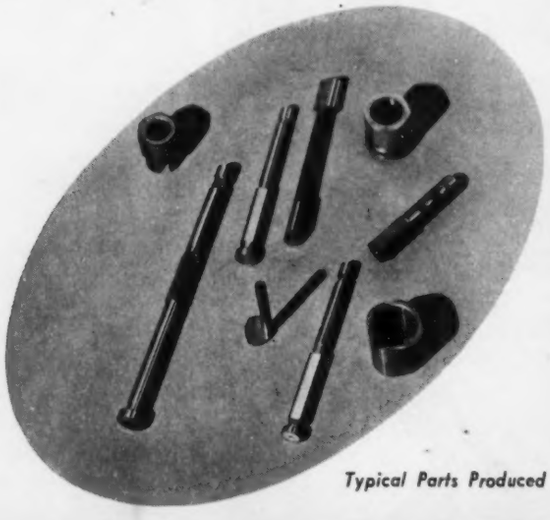


Cam Grinder Unit Ready for Mounting on Grinder

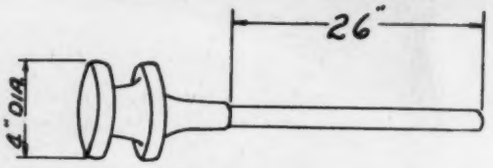
CAMS . . *odd shaped parts . . . are produced on* OHIO MULTIPLE CAM GRINDER UNITS. The Ohio Multiple Cam Grinder Units are compact . . . sturdily built and designed for mounting on practically ALL STANDARD CYLINDRICAL GRINDERS.

These cam grinders incorporate an exclusive principle of contour control, found in no other machines and provide advantages in production, duplication, and most important of all, accurate parts. They have been thoroughly proven as a valuable unit by years of satisfactory service with leading manufacturers in all types of industries. Constantly, new applications are being found where they save time and money and increase the accuracy of a product.

If yours is a cam problem, you will save both time and expense by consulting our engineers. Write for our catalog which describes these machines thoroughly, and shows you why we can duplicate accurate parts to close limits.



Typical Parts Produced



SUPERFINISHING two diameters simultaneously

Here is a job that requires a fine finish at a high production rate. This piece has a SUPERFINISH surface approximately 25" long and 1½" in diameter and two surfaces approximately ½" wide and 4" in diameter. The SUPERFINISHING on all these surfaces are done simultaneously. Two SUPERFINISHING heads are used—the one at the left is stationary and the stones are oscillating while the work is being revolved on the two flanges. The other head is mounted on a separate table which automatically traverses in both directions on the bed covering the entire length of this bearing surface which is approximately 25" long. On this same machine many other parts can be SUPERFINISHED. A flat SUPERFINISHING attachment can be attached to this machine. We have mounted as many as ten SUPERFINISHING heads on a single machine, doing that many operations simultaneously.

The machine is of simple design with motor and pump for the lubricating and SUPERFINISHING liquids self-contained and incorporated in the design. If your work requires ultra smooth surfaces you should investigate modern SUPERFINISHING as obtained on the OHIO UNITS SUPERFINISHER.

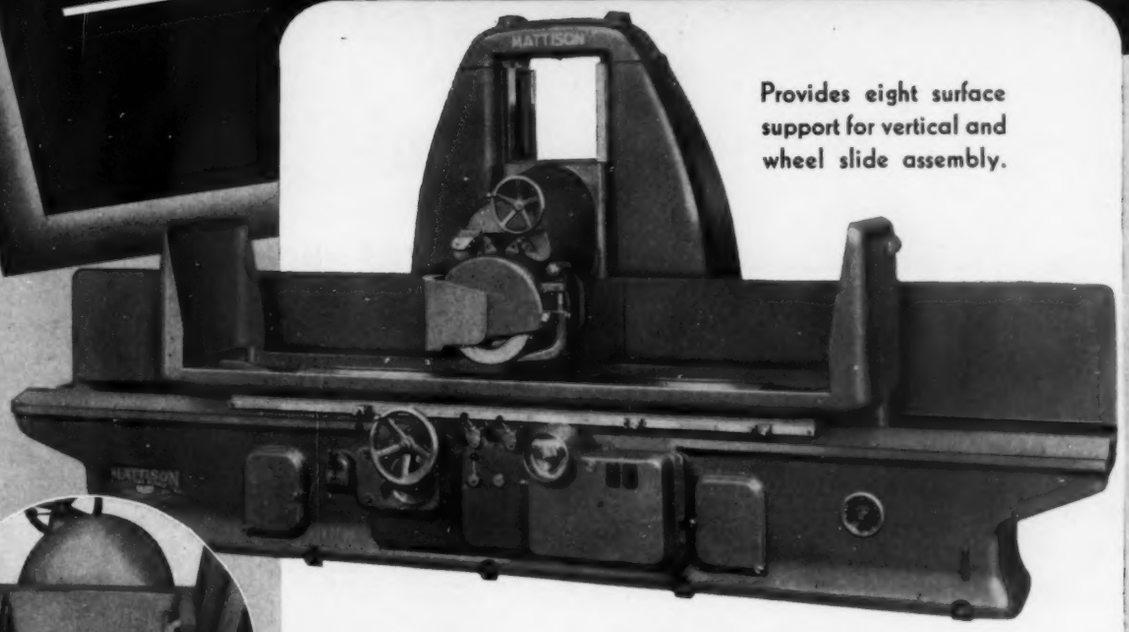
Send samples for SUPERFINISHING or send us your blueprints for recommendations and ask for our latest bulletins on SUPERFINISHING.

OHIO UNITS • MANUFACTURERS • DAYTON, OHIO, U.S.A.

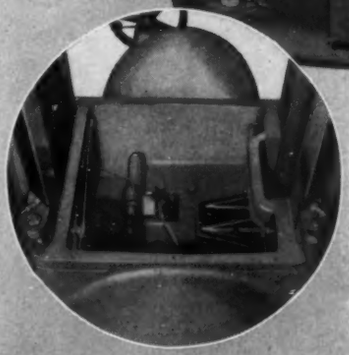
MATTISON

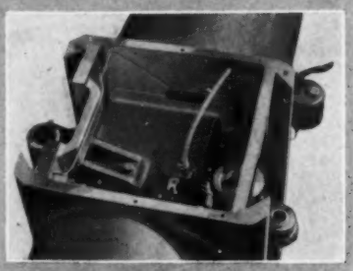
HIGH-POWERED PRECISION SURFACE GRINDER

Not One Column...But Two



Provides eight surface support for vertical and wheel slide assembly.





AN outstanding characteristic of the Mattison Surface Grinder is the massive double column support for wheel slide assembly. The housing in which the grinding wheel and its motor are mounted is exceptionally heavy and is carried on large horizontal ways of the vertical slide. This assembly is in turn supported between *two* heavy cast columns. Wide bearing surfaces on the inside face of each column and dovetail bearing surfaces on the front and back of each column provide an eight surtace support, eliminating side rock and insuring stability regardless of direction of table travel.

Lower costs, speedier production and a fine finish are advantages gained by installing a Mattison High-Powered Precision Surface Grinder. Table Sizes: Width 12" to 36"—Length 36" to 192". We invite you to send prints of your work for production estimates.

PRECISION CRAFTSMEN *Need Precision Tools*

. . . Be Sure of Large Diameter Precision with Davis Tubular Micrometers

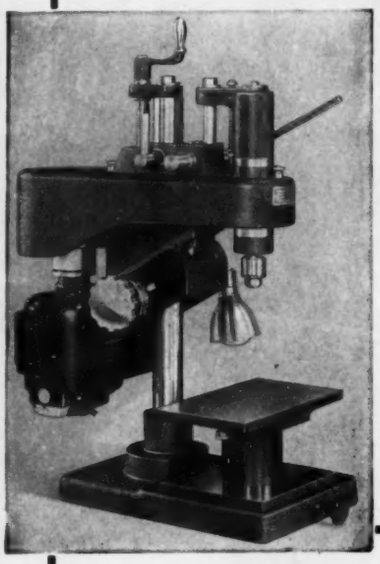
Check with a Davis Tubular micrometer and you're sure of accuracy to the tenths of a thousand of an inch — for you can detect the slightest touch with a "Davis." Durably constructed for lasting accuracy. Available in crescent and bar types in 45 different sizes, each equipped with a sliding ground bar and a micrometer head.

Write for bulletin.

DAVIS & THOMPSON CO., ***Milwaukee, Wis.***

DAVIS
Tubular Micrometers
. . . made by the builders of DAVIS Continuous Milling and Drilling Machines and other High Production Machines.

INVESTIGATE
THE NEW "VARIMATIC"—
an outstanding development in
SUPER-SENSITIVE DRILLING MACHINES



featuring

Infinite speed variations in two ranges of speeds—

Instantaneous change of speeds in each speed range.

Complete speed range from 840 to 9300 RPM.

Capacity from .004" to 5/16" in all materials.

Vertical adjustment 6½" by means of elevating screw.

Precision built for precision work—modern up-to-the-minute-convenient-sturdy.

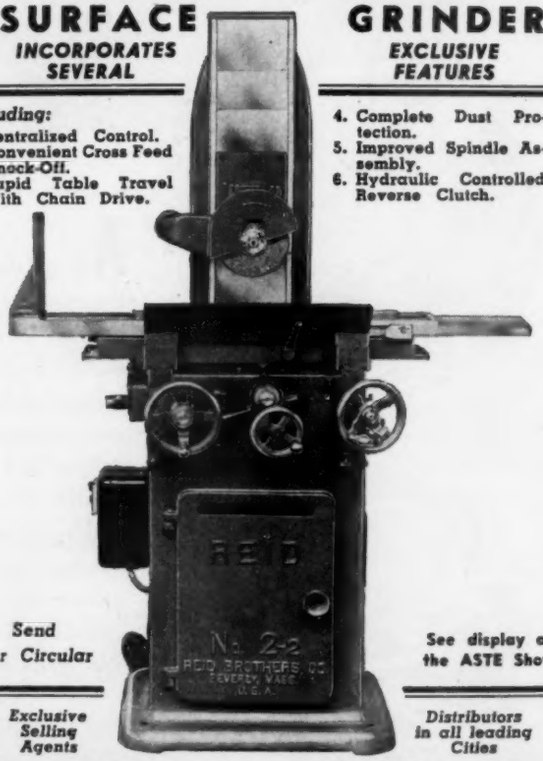
Write for complete detailed specifications of the Varimatic.

THE HAMILTON TOOL CO.
9th & Hanover Sts. **HAMILTON, OHIO**

THE REID POWER-FEED SURFACE GRINDER
INCORPORATES SEVERAL EXCLUSIVE FEATURES

Including:

1. Centralized Control.
2. Convenient Cross Feed Knock-Off.
3. Rapid Table Travel With Chain Drive.
4. Complete Dust Protection.
5. Improved Spindle Assembly.
6. Hydraulic Controlled Reverse Clutch.



Send For Circular

See display at the ASTE Show

Exclusive Selling Agents

Distributors in all leading Cities

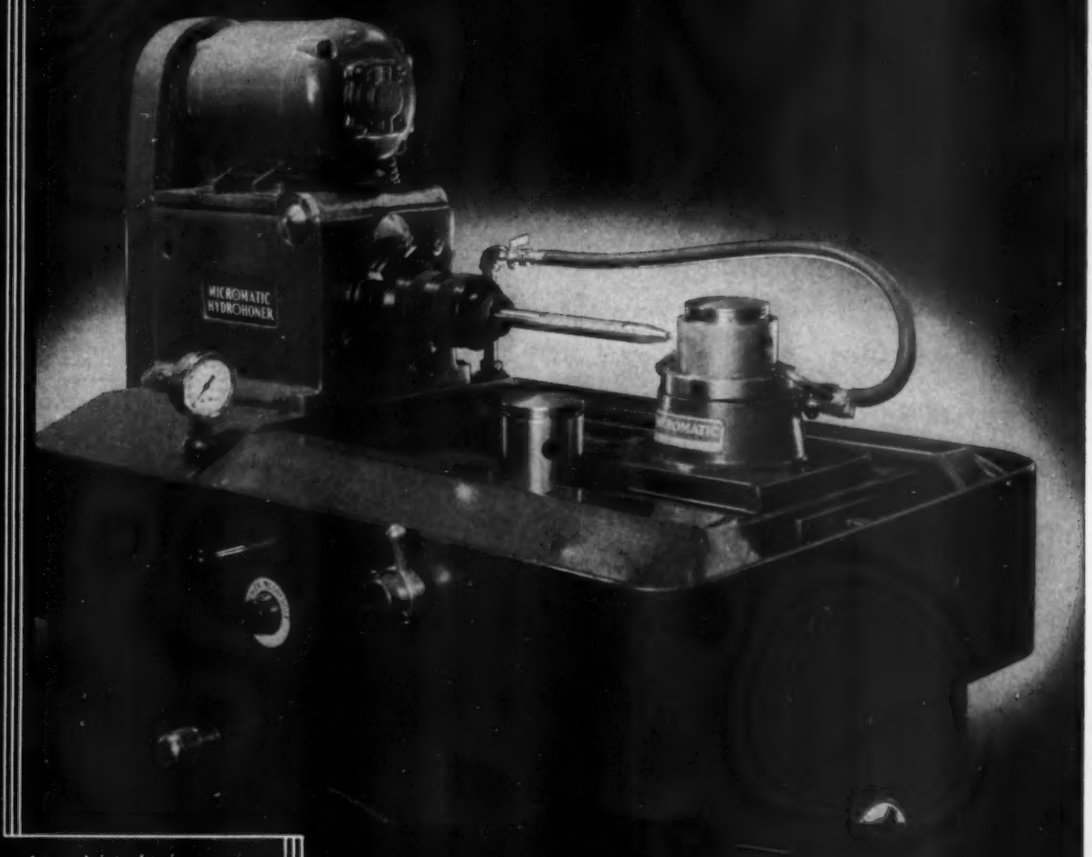
H. LEACH MACHINERY CO.
387 Charles St., **Providence, R. I.**

New

MICRO MATIC

TRADE MARK

Automatic MICRO SIZE Control WITH MICROMATIC HYDROHONER



Visit Booth 108 AT 1941 A.S.T.E. MACHINE & TOOL PROGRESS EXPOSITION

The Automatic Micr-O-Size Control Unit generates accurate sizing in high production, uniformly within limits from .0002" to .0005", reducing tolerance range and number of selective fits.

It offers increased production through simplified practice. Write for Bulletin A.R.-60.

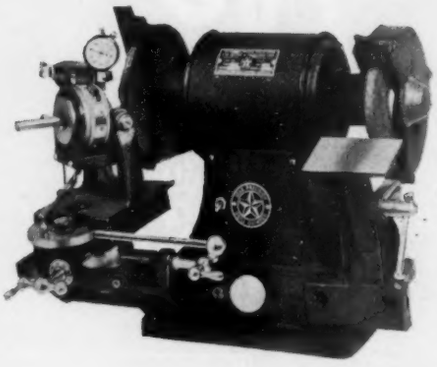
MICROMATIC HONE CORPORATION

1345 East Milwaukee Ave.
DETROIT, MICHIGAN

Solve Your Tool Grinding Problems This Easy Way

• Investigate Cost-cutting features of the STAR PRECISION GRINDER

Perfect points are easily ground by semi-skilled mechanics on this dependable Precision Drill Grinder. It's simple, speedy, and economical to operate—assuring lower drilling costs and lower grinding costs as well. Outstanding features of the Star Precision Drill Grinder include: a capacity of 81 drill sizes from $\frac{1}{8}$" to $\frac{1}{2}$", numbered drills from 1 to 30, and all letter size drills; easy angle adjustment; two wheels readily accessible for rough and finish grinding. You will save money with the Star Precision Drill Grinder because actual grinding time is reduced, intervals between grinding are increased, drills will cut freer and permit higher speeds and coarser feeds, and it will take less time to set up your jobs. The Star Grinder guarantees holes of correct size without gauging or drilling of trial holes. It will pay you to get *all* the facts on this unusual Drill Grinder. No obligation.



•

Complete details on request

STAR MACHINE & ENGINEERING CORP.
Div. Star Electric Motor Co. Bloomfield, N. J.

Here It Is! NEW TYPE NT CABINET BASE KNIFE GRINDER BY ROGERS

Backed by 54 Years' Experience

PRECISION Grinding Results on a high production basis, are provided by this new, *heavy-duty, cost-reducing* grinder. Most modern, reasonably-priced machine of its type available.

NEW FEATURES

Automatic forced feed lubrication of ways; extra large V way; disc type clutch transmission; double surface knife bar; segmental grinding wheel.

Send for details; giving maximum length of knives.

Type NT Sizes 70", 90", 110", 132". Larger on special order.

SAMUEL C. ROGERS & CO.
197 Dutton Ave., Buffalo, N. Y.

ROGERS KNIFE GRINDERS
PRECISION QUALITY SINCE 1887

NEW *Vernon* VERTICAL MILL AND JIG BORER
THE *ONLY* MACHINE IN THE LOW PRICE FIELD on which JIG BORING Equipment can be furnished as a *standard extra.*

Equipped with **Dial Indicators** and **Measuring Rods** as illustrated, the *Vernon* is invaluable for **smaller Jig Boring operations,** relieving or replacing heavier, higher priced machines.

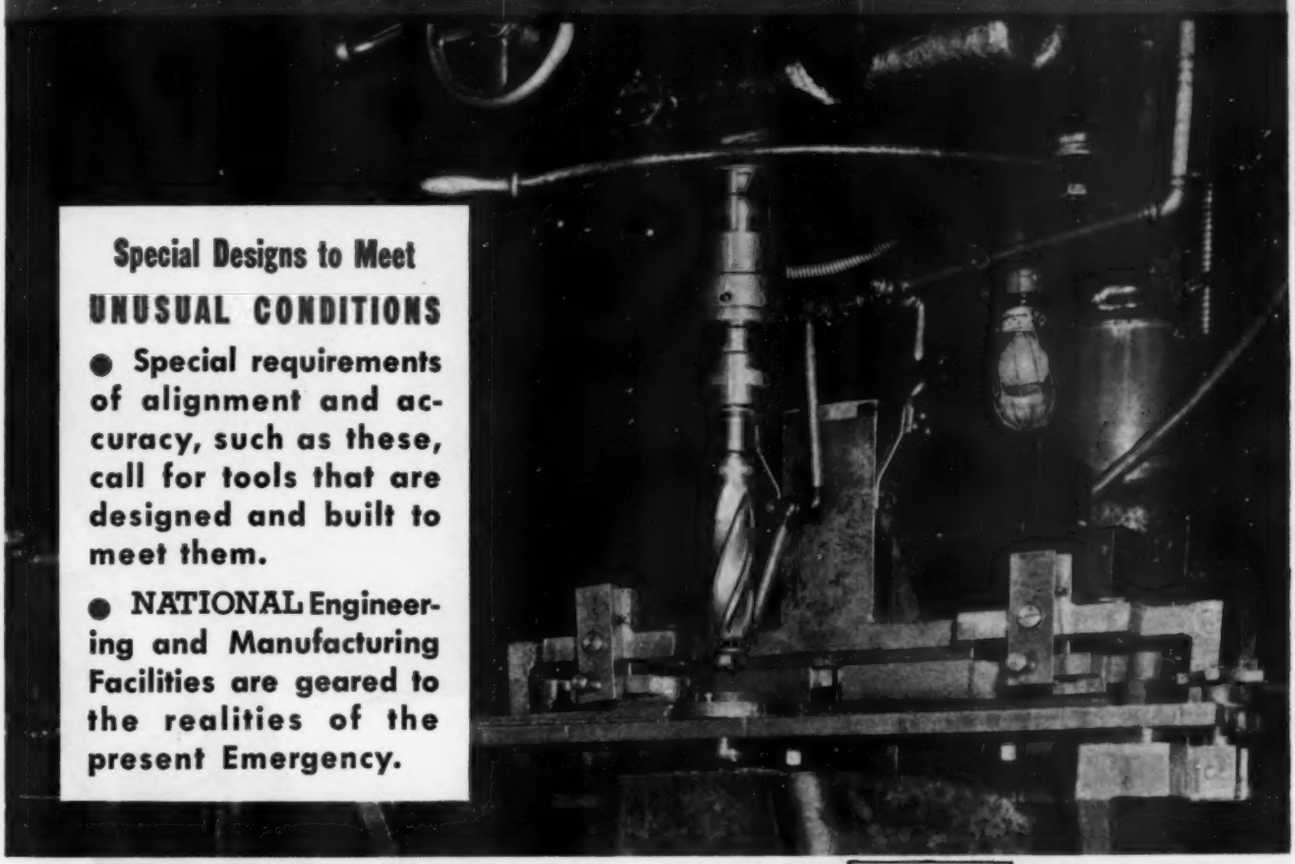
PROMPT DELIVERIES

WRITE FOR FOLDER GIVING SPECIFICATIONS AND PRICES

MACHINERY MANUFACTURING CO.
1915 E. 51 ST., VERNON, LOS ANGELES, CALIF.
The Vernon Line of HORIZONTAL MILLING MACHINES, COMBINATION VERTICAL MILLING MACHINES & JIG BORERS, & 11" SHAPERS

AT WORK IN DEFENSE OF THE NATION

NATIONAL *METAL CUTTING TOOLS*



Special Designs to Meet
UNUSUAL CONDITIONS

- **Special requirements of alignment and accuracy, such as these, call for tools that are designed and built to meet them.**
- **NATIONAL Engineering and Manufacturing Facilities are geared to the realities of the present Emergency.**

NATIONAL

NATIONAL TWIST DRILL & TOOL CO. DETROIT U.S.A.

REAMERS, HOBS
MILLING CUTTERS
COUNTERBORES
SPECIAL TOOLS

TWIST DRILL AND TOOL COMPANY

Home Office and Factory—DETROIT, MICH.
Tap and Die Division—Winter Brothers Co., Wrentham, Mass.

Factory Branches • New York • Chicago • Philadelphia • Cleveland • San Francisco • Distributors in Principal Cities

This ARTER *combines*

SIMPLICITY OF OPERATION
EXTREME PRECISION
and
INCREASED OUTPUT!

● Small wonder that this Arter Rotary Surface Grinder—one of three Model A-1-12 machines in the Fellows Gear Shaper plant at Springfield, Vermont—is reported as being "suited to the job."

Work being handled on this machine is that of grinding both ends of a case hardened steel worm which when finished must run dead true and be free from chatter.

With this Arter-in Action, 16 pieces are finished per hour, which is "double production" over the method formerly employed for handling the operation.

Arter Rotary Surface Grinders can always be depended on to save time, improve finish, and cut costs, because they are designed for fast, close tolerance work, are rigid in construction and remarkably simple in operation.

Why not let our engineers study your grinding problem and show you how Arter Rotary Surface Grinders can be suited to your job of getting out more and better work.

●

Write for detailed specifications on Arter Rotary Surface Grinders—available in Light Series Type in 8" and 12" sizes and in a Heavy Type in 12" and 16" sizes. Hydraulically operated models in capacities from 16" to 40".

●

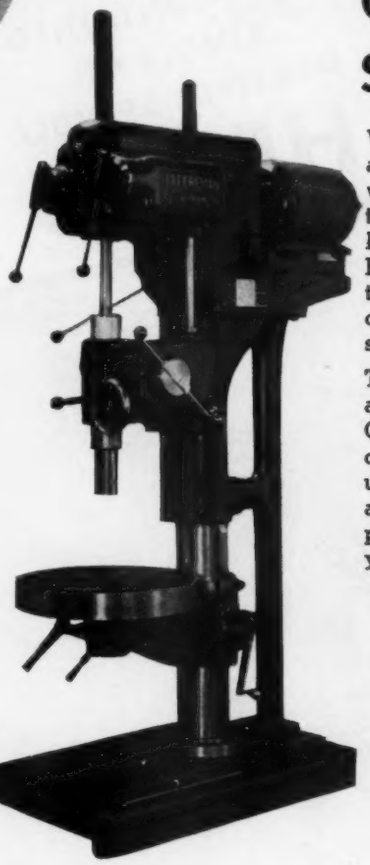
ARTER

GRINDING MACHINE CO.

Worcester, Mass., U.S.A.

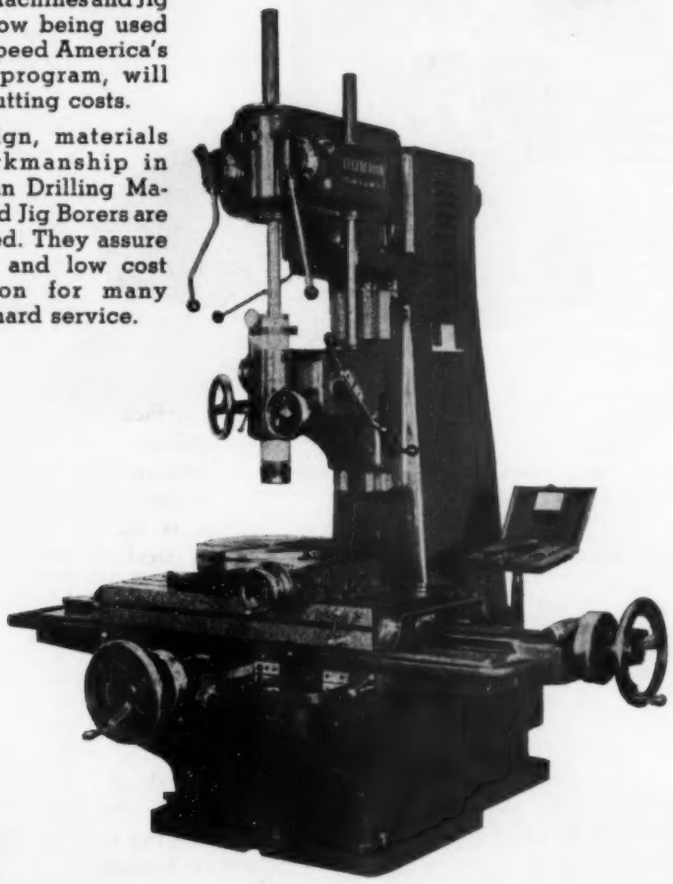
When Peace Comes ☆

Cleereman Machines Will Still Be Cutting Costs



When the rush of rearmament is past, and the world has turned to peacetime work, Cleereman Drilling Machines and Jig Borers, now being used to help speed America's defense program, will still be cutting costs.

The design, materials and workmanship in Cleereman Drilling Machines and Jig Borers are unexcelled. They assure accuracy and low cost production for many years of hard service.



Address
Bryant Machinery & Engineering Company
400 W. Madison St., Chicago, Ill., U. S. A.
Sales Division of
Cleereman Machine Tool Company

CLEEREMAN

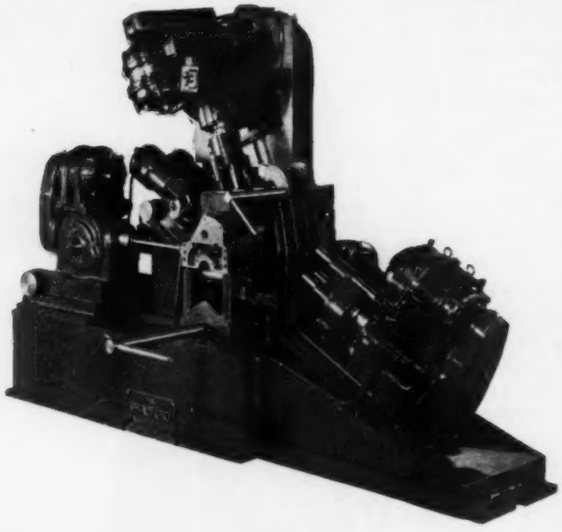
DRILLING MACHINES and JIG BORERS

THE SIMPLEST WAY TO SOLVE COMPLICATED DRILLING AND TAPPING PROBLEMS...

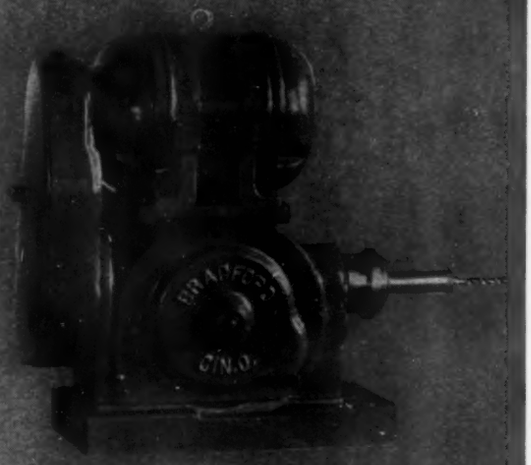
BRADFORD
UNIT-TYPE SELF-CONTAINED SINGLE OR MULTIPLE SPINDLE HEADS

For Instance—

...ON CYLINDER BLOCKS, THIS MACHINE TURNS OUT MORE THAN 65 PIECES PER HOUR!



● A sterling example of Bradford's application of their Self Contained Single or Multiple Spindle Heads is this 5 unit machine performing various tapping and drilling operations on automobile cylinder blocks. The sole duty of the operator is to load the blocks in the roller type fixture, and remove them when finished . . . *all other operations are completely automatic.* A pilot light on the push button station in front of the operator notifies him when the machining cycle is complete, thus eliminating the human element that might cause serious wastage. Surely, this combining of Bradford Heads with Special machine set-ups into one time saving, profit making, automatic or semi-automatic unit, indicates the value it can be to *you in your plant.* These heads come in a wide range of sizes and speeds for both light and heavy duty service.



BRADFORD SINGLE SPINDLE DRILLING UNIT

●

Unit same as above can be furnished for tapping . . . is of the electric reversing motor type

●

LET US KNOW YOUR PROBLEM . . . WE'LL FIGURE A WAY TO SOLVE IT!

Our engineers have had plenty of experience ironing out complicated production problems, so as to simplify the operation, increase capacity, and reduce per-piece-cost. Why not send us a sample (or blueprint) of one of your more troublesome parts and let us estimate on how much better and faster you can machine it with *Bradford Unit-Type Heads?* There's no obligation, so you've got everything to gain!

THE BRADFORD MACHINE TOOL CO.
CINCINNATI, OHIO
MAKERS ALSO OF BRADFORD GEARED HEAD LATHES

PRECISION TOOLS SINCE 1840

BARNESDRIL

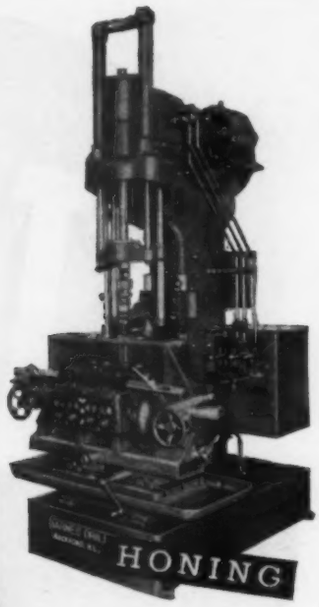
Combination Boring and Honing Machines

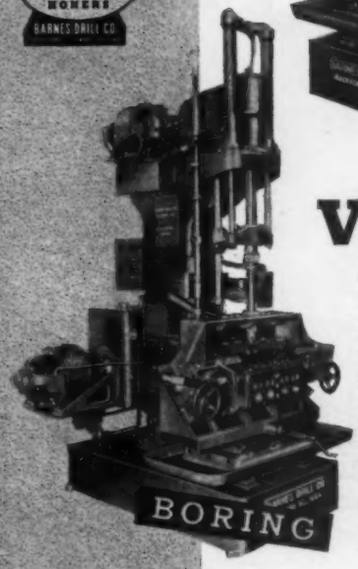
DRILLERS BARNESDRIL HONERS BARNES DRILL CO.

BARNESDRIL Honing Machines are built in all sizes and types to hone anything for which a honing tool can be made. Pioneers in the field, our engineers have developed a host of highly successful applications in which BARNESDRIL Vertical and Horizontal Honing Machines speed production, cut costs, hold close limits and maintain high quality finish in a wide variety of work-pieces.

Always available are BARNESDRIL Combination Machines in which work-pieces can be drilled, bored, reamed . . . and honed in the same setting simply by changing tools and shifting to the hydraulic honing circuit.

When figuring new equipment use our free engineering service for most suitable applications of BARNESDRIL Combination Boring and Honing Machines, High-Production Honers; Self-Oiling, All-Geared and Hydram Machines for drilling, boring, reaming and similar operations. Investigate *today*.



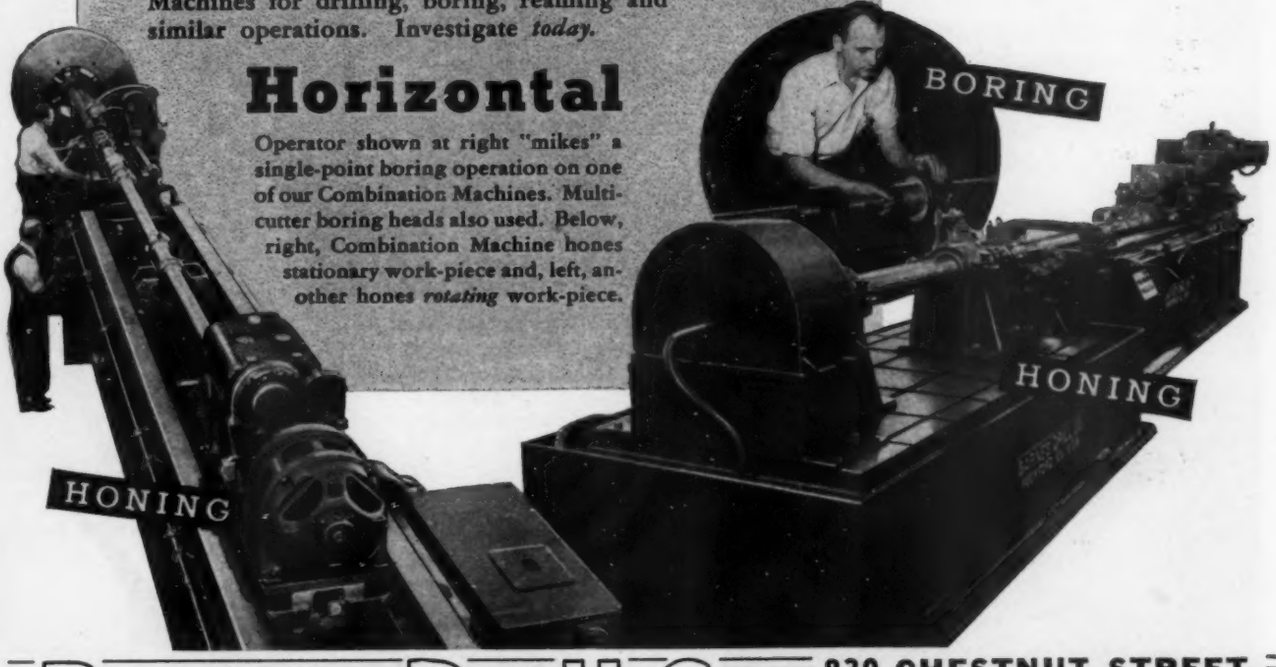


Vertical

Illustrated at left is our No. 306-C Combination Machine set up for reboring multiple-cylinder blocks progressively. Above, same machine is shown as set up for honing the same cylinder-bore by substituting a honing tool and shifting to the hydraulic circuit for this operation. Below are views of Horizontal Boring and Honing. All machines shown have exclusive patented features.

Horizontal

Operator shown at right "mikes" a single-point boring operation on one of our Combination Machines. Multi-cutter boring heads also used. Below, right, Combination Machine hones stationary work-piece and, left, another hones *rotating* work-piece.



Barnes Drill Co. 830 CHESTNUT STREET ROCKFORD ILLINOIS, U. S. A.

MADE IN ROCKFORD, ILLINOIS, U. S. A.

STOP PAYING HOMAGE TO OBSOLESCENCE

INSTALL Avey DRILLING and TAPPING MACHINES

The extra precision . . . extra quality . . . extra service built into AVEY machines are the very things to wipe out excessive obsolescence penalties along the production line . . . and to meet modern high speed production requirements. Compare AVEY features point for point for a full appreciation of what they mean in lower drilling and tapping costs. Write for illustrated and descriptive literature.

THE AVEY DRILLING MACHINE CO.
CINCINNATI, OHIO

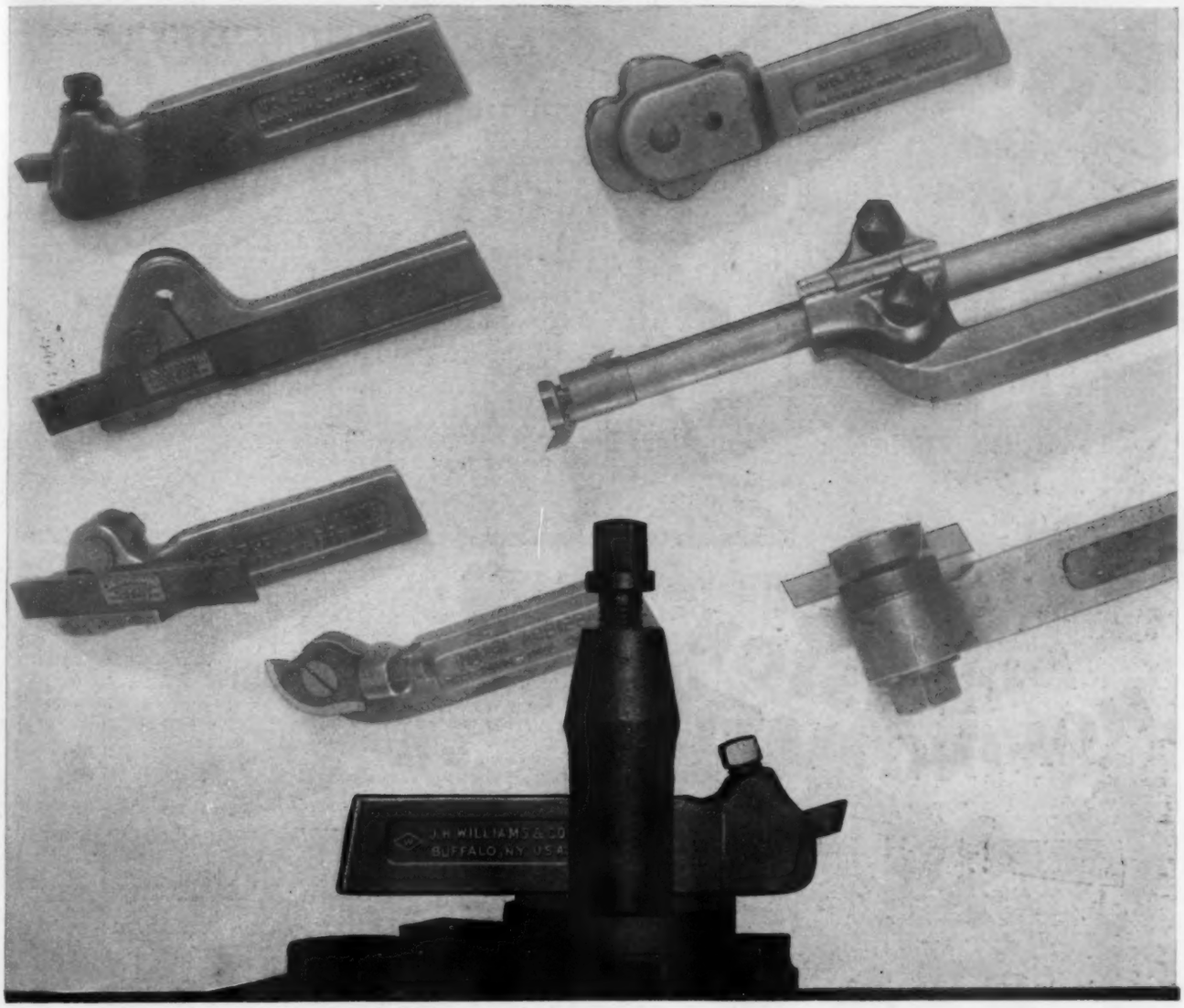
1-Motor-Avey for intensive high speeds. 2-Motor-Avey Matic for regular production. 3-Avey-Matic high duty drilling machine . . . belt driven. 4-Standard belt drive No. 2 Avey Drilling Machine. 5-Bench Type Motor-Avey for intensive speeds.

1/4" TO .010

Avey

DRILLING MACHINES

BUILT TO DO THE JOB FASTER AND BETTER



WILLIAMS' TOOL HOLDERS FOR "ALL-OUT" PRODUCTION

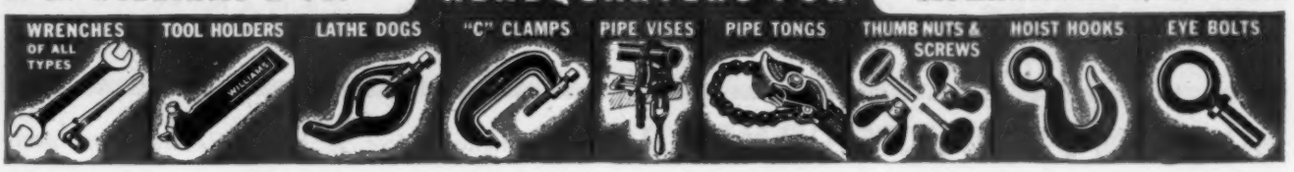
A sure way to meet today's demand for maximum machine production is to "tool-up" with Williams' Holders. Not only does Williams' line provide a type for every regular operation of lathe, planer and shaper but many of these holders incorporate time and labor-saving features which production men cannot afford to overlook in the light of national needs.

Williams' design is such that you can expect consistent, accurate production from these tools under severe conditions. Careful broaching of cutter channels, accurate machining and thorough hardening are but a few of the manufacturing precautions taken by Williams to assure dependability and top performance.

All Williams' Tool Holders are fully guaranteed, and are sold by industrial distributors everywhere. Illustrated literature will be sent on request.

I-673

J. H. WILLIAMS & CO. HEADQUARTERS FOR **225 LAFAYETTE ST., NEW YORK**



SUNNEN

TIME CUT FROM
20 minutes to less than 1 minute
COST CUT FROM
20c to 2.8c

A manufacturer of hydraulically operated dump bodies was taking 20 minutes to lap a valve body at a cost of 20c each. The Sunnen Precision Honing Machine now does the job in less than a minute at a cost of 2.8c! Naturally the Sunnen Precision Honing Machine can't show such sensational savings on all jobs but it is helping hundreds of manufacturers to economically produce more accurate holes with better surface finishes. What's your problem? Why not tell us about it?

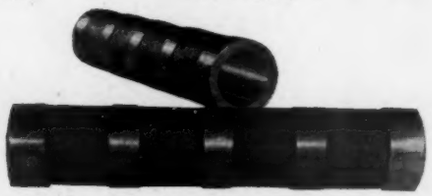
PRECISION HONING MACHINE

Miniature Model Airplane Cylinders "Eliminates expensive machine set-up."

Stone Lettering Air Hammer "Sunnen honing does in five minutes what it took 20 minutes to do by lapping."

"Produced an extremely accurate and glass-like finish."

Diesel Engine Fuel Injector Cylinder "So accurate that a piston can be fit within .00005 in."



"A perfectly straight round hole with a mirror finish."

Drill Jig Bushing "Increases sales appeal of product."

"Strict alignment maintained between two holes."

Drawing and Blanking Die "Saves time in producing smooth base metal finish."

Rubber Eraser Extrusion Die "Tripled life of extrusion dies."

Inner Bearing Ring "Accurately removes last 'tenth' of stock."

- **Immediate Delivery**
- **Low in Cost**
- **Easy to Use**
- **Economical**
- **One-Minute Set-Up**

Accurately sizes and finishes internal cylindrical surfaces from .185" to 2.400" in diameter! Produces super-smooth surface finish. Accuracy within .0001" guaranteed.

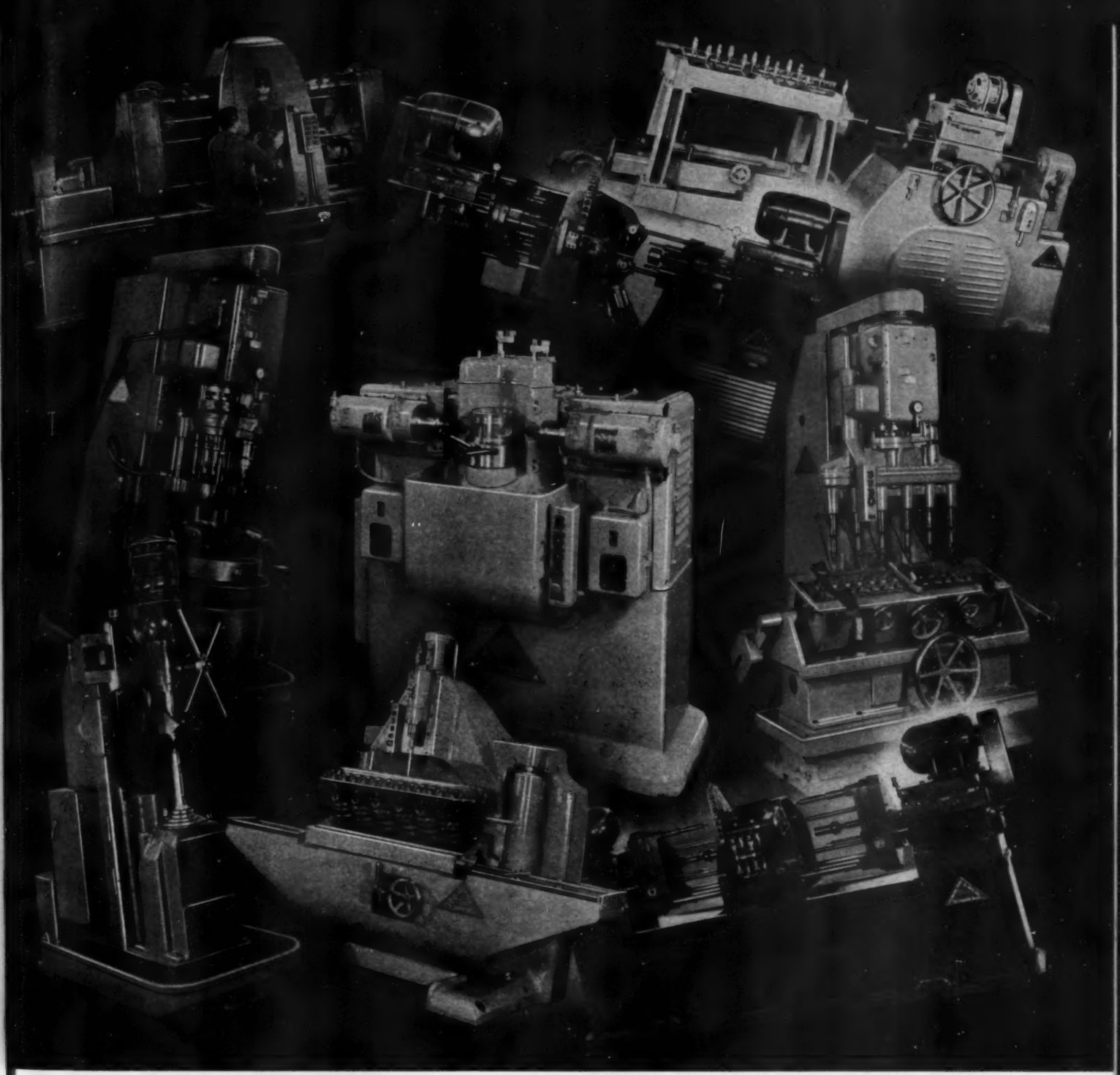
Does not require skilled, experienced operator — any intelligent workman with a few hours' practice can produce precision workmanship.

Used in hundreds of plants — particularly by manufacturers engaged in the defense program.

A Sales Engineer will be glad to call and demonstrate this machine in your plant. Write for FREE 8-page bulletin.

SUNNEN

SUNNEN PRODUCTS COMPANY 7941 Manchester Ave., St. Louis, Mo. • Chatham, Ontario



March of Le Maire Hydraulic Machines

Shown above from left to right are:

Upper row: No. 60 Horizontal Two-way drilling and boring machine, special four-way drilling and boring machine, line boring machine.

Middle row: No. 10 Vertical drill with motorized index table, piston profile machine, No. 10 vertical spot facing machine.

Lower row: Shell centering machine, diamond boring machine, special two-way horizontal drilling machine.

Save Time and Money

Investigate What Le Maire
Has To Offer You — TODAY

LE MAIRE PRECISION PRODUCTS

Visit Booth No. 365 at the
A. S. T. E. SHOW

LE MAIRE TOOL & MANUFACTURING COMPANY

2655 SOUTH TELEGRAPH ROAD - DEARBORN, MICHIGAN

Use this **EMPCO UNIT**

(produced under Millholland patents)

and keep your tools

ACTUALLY PRODUCING

80% to 88% of working time

Empco Units can form the fastest production machines for rotary tool operations, and they lend themselves to a wide diversity of adaptations. This greater production is made possible through the specially designed cam which utilizes the pneumatic counterbalance to the best advantage. Cutting time is measurably increased and idle time is reduced to a minimum. Empco Units produce any given number of pieces in less time. Light or heavy work.

The use of plate type cams, simple feed, and speed gears, and the interchangeability of parts and same size units, permit change-over with minimum cost.

Empco Units are adaptable for drilling, reaming, tapping, broaching, spotfacing and milling (either singly or in multiples or groups). Full automatic cycle with interlocked controls permits groups of units to operate from central control point.

Write for illustrated descriptive folder

EMPCO

ENTERPRISE
MACHINE PARTS CORPORATION
2725 JEROME AVENUE • DETROIT, MICHIGAN

DEFENSE TOOLING MUST BE QUALITY TOOLING...

WITHOUT DELAY

Index is ready to serve you. Increased capacity in modern plant has made it possible to give you good deliveries on a tool room machine at *one-third the price you have in mind.*

Meet the rigid accuracy requirements of Government work with this combination unit.

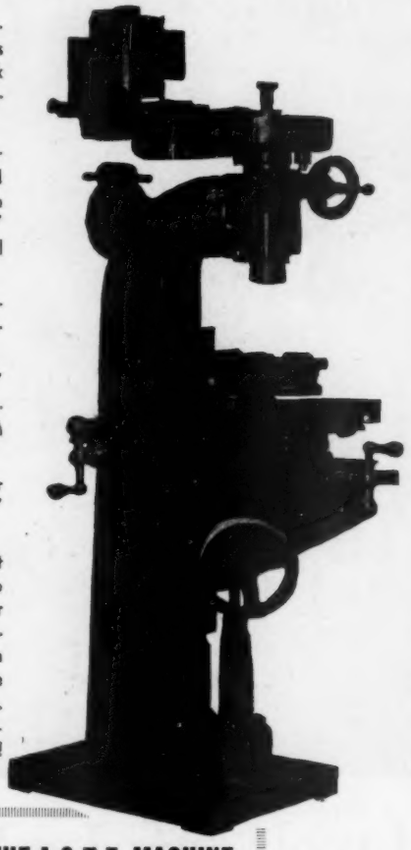
IT MILLS slots, keyways, cavities and irregular curves with end mills 1/8" to 3/4" diameter in tool steel.

IT DRILLS to accurate locations without layout.

IT BORES up to 3" holes in steel — vertical, horizontal or at angles.

HAS VERNIERS for locating 8" x 16" at one setting.

Constant repeat orders testify to the performance of our machines . . . performance that can be duplicated in your tool room. Write to us for details and quotations!



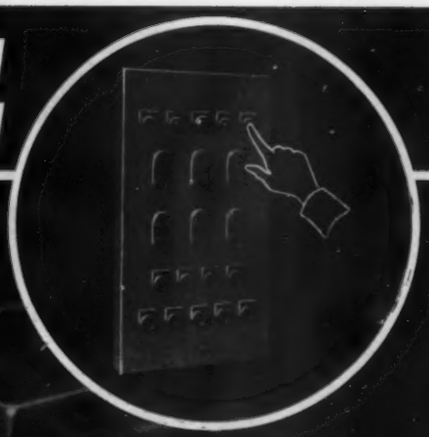
...GOING TO THE A.S.T.E. MACHINE & TOOL PROGRESS EXHIBITION?

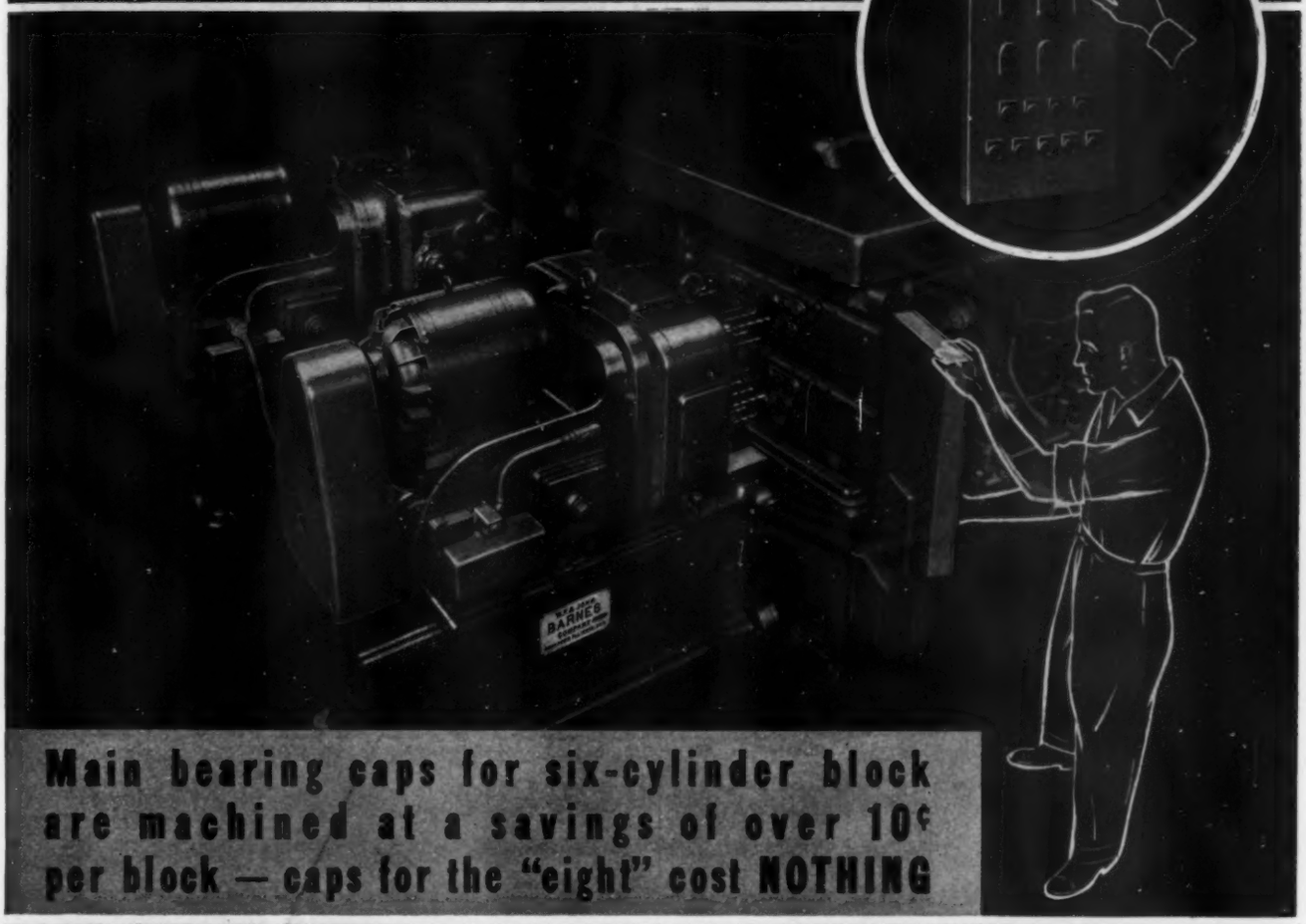
Visit our Booth, No. 159 at the Convention Hall, Detroit—March 25th to 29th, 1941—and see a machine in action!

BLANK & BUXTON MACHINERY CO.

3106 E. Michigan Ave., Jackson, Mich.

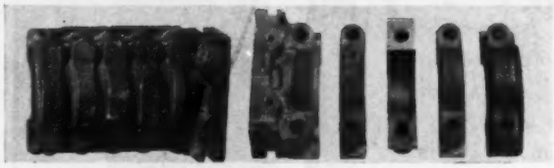
HERE'S WHAT CAN HAPPEN WHEN YOU POKE A BUTTON





Main bearing caps for six-cylinder block are machined at a savings of over 10¢ per block — caps for the "eight" cost NOTHING

WHEN YOU CAN'T HIRE SKILL, HAVE BRAINS BUILT INTO YOUR MACHINES



MACHINE IN BRIEF—Main bearing caps, for both a six and eight-cylinder engine, enter this machine in solid iron as shown in photo. They leave drilled, reamed, tapped, notched for retaining bearing liners, and sawed apart. The fixture is double decked to accommodate the caps for the eight and six-cylinder engine. Production is 87 of each size per hour.

Aside from fixture and tooling, this machine is built from our standard self-contained hydraulic units.

The machine cycle is automatic. For continuous operation the machine operator need only load the caps into the machine. Unloading is entirely automatic.

This machine represents a highly successful solution to one production problem. Yours will be different but perhaps equally as efficient.

Machines, like this one, work as if they had minds of their own. And minds of metal never tire, never change, never make mistakes . . . *and thrive on routine.*

In times of shortage of skilled labor you can use this type of design service to advantage. Perhaps an analysis of your part and production methods will reveal the need for a simple machine, easy to operate. It may lead to a more intricate machine—but equally simple to operate. It may make that contemplated purchase of a battery of standard machine tools, needing a squad of experienced operators, look like a foolish investment.

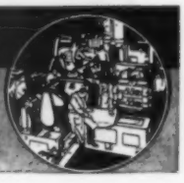
An example of the results of our work with an automobile manufacturer is described to the left. We've had a lot of experience in designing and putting our standard units together in various forms of special machine tools and would welcome the chance to work with you on your machining problems.

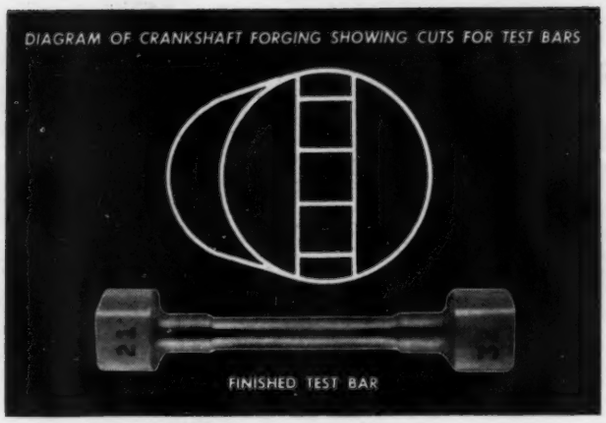
Our booklet "Since 1872 . . . " illustrates how it has worked for others . . . send for your copy.

W. F. AND JOHN BARNES COMPANY

ROCKFORD • • • • ILLINOIS

DESIGNERS AND BUILDERS OF DRILLING—BORING—TAPPING—MILLING AND HONING MACHINES TO SUIT YOUR PARTS — YOUR PRODUCTION





75% reduction in cutting time with CAMPBELL CUTAMATICS

This was a crankshaft job—a real production job. Tests required bars from the center section of each forging. Time for preparing the test bars became the bottleneck.

Campbell Cutamatics reduced time 75% by making faster, cleaner cuts—getting better specimens from center of shaft—speeding set ups.

Fewer Cutamatics did more work in less time at a big saving—and kept production on an even keel.

★ ★ ★

IMPORTANT DEFENSE JOBS CUT ON CAMPBELL MACHINES

CAMPBELL ABRASIVE CUTTING MACHINES

Aircraft Crankshafts
Aircraft Valve Stock
Aircraft Piston Stock
Aircraft Valve Tappet Guides
Aircraft Laboratory Cutting
Gun Barrel Stock
Machine Gun Stock
Cutting Armor Plate for Laboratory
Forging Blanks

CAMPBELL NIBBLING MACHINES

Aircraft Alloy Sheet Stock
Aircraft Tubing
Aircraft Gas and Oil Tanks
Army Truck Sheet Stock

Write for booklet "Design for Cutting Costs." It may contain a solution to your own cutting problems.

ANDREW C. CAMPBELL DIVISION
Designers and Builders of Special Machinery
BRIDGEPORT, CONNECTICUT

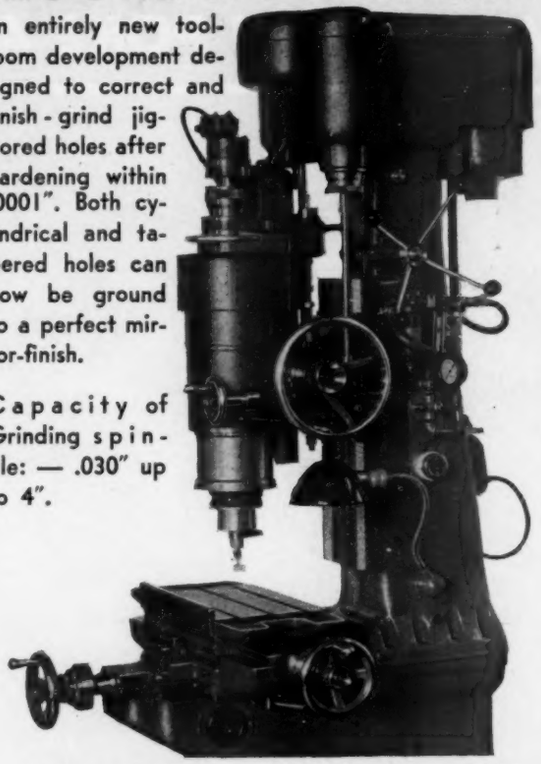
In Business for Your Safety

AMERICAN CHAIN & CABLE COMPANY, Inc.

MOORE JIG GRINDER

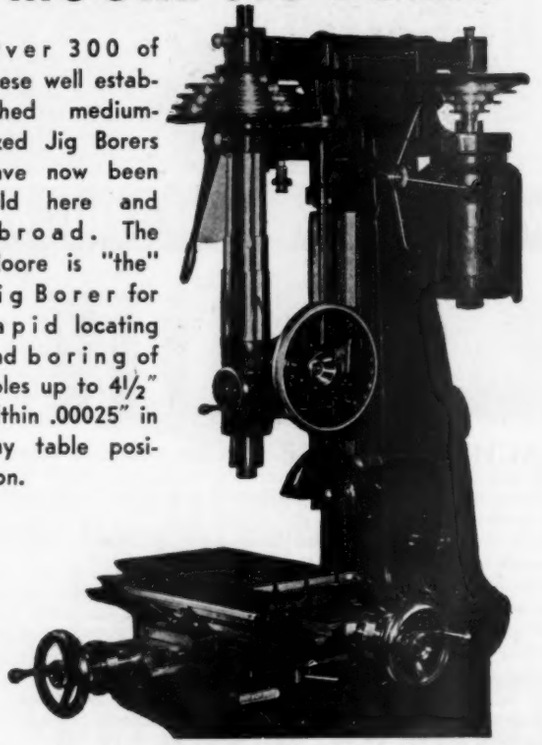
an entirely new toolroom development designed to correct and finish-grind jig-bored holes after hardening within .0001". Both cylindrical and tapered holes can now be ground to a perfect mirror-finish.

Capacity of Grinding spindle: — .030" up to 4".



MOORE JIG BORER

Over 300 of these well established medium-sized Jig Borers have now been sold here and abroad. The Moore is "the" Jig Borer for rapid locating and boring of holes up to 4½" within .00025" in any table position.



See these machines in operation at the ASTE Show —Booth No. 206

Sole distributors:—

MARBURG BROS., INC.
West St. NEW YORK

PRECISION THREADS

Regular and Second Operation Threading

No. 11 Threading Machine for small diameter, fine pitch threads in N.C. series up to 5/16", finer pitches up to 9/16".

Now, The Geometric Tool Company can offer you a complete line of up-to-date Threading Machines with two new sizes (No. 11 and No. 16) recently placed on the market.

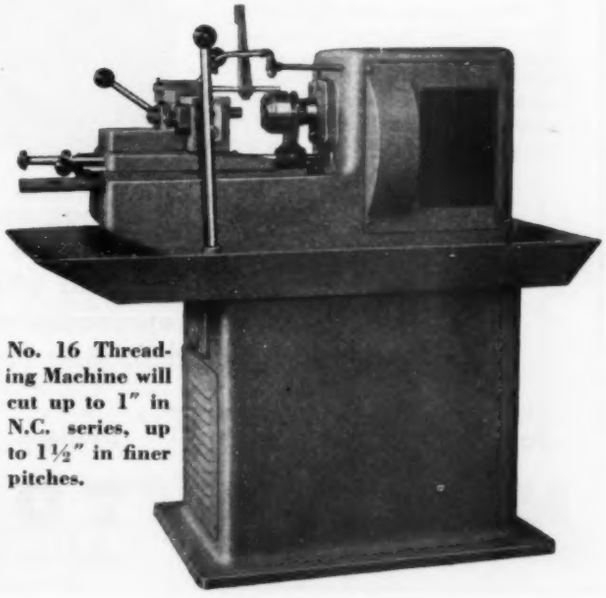
Among the outstanding features are:— Vertical and horizontal work holder alignment; hardened ways; anti-friction spindles; wide ranges of speeds; and most important of all, ability to turn out threads to exacting limits.

No. 14 Threading Machine will cut threads up to 9/16" in N.C. series, up to 1" in finer pitches.

As proof of their ability to do accurate work at fast speeds we offer one outstanding fact. Approximately 75% of all the No. 14 Machines built (put on the market 3 or 4 years ago) are used in the production of airplane parts where, as you know, the tolerances are close and the materials tough.

Send for your copy of the New Geometric Threading Machine Booklet.

Geometric also makes Self-Opening Die Heads and Collapsing Taps.



No. 16 Threading Machine will cut up to 1" in N.C. series, up to 1½" in finer pitches.

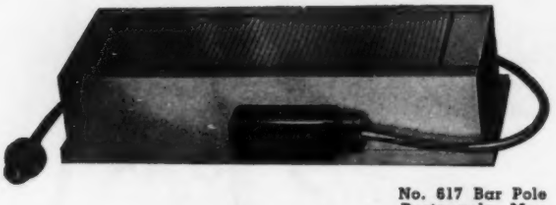
THE GEOMETRIC TOOL CO.

New Haven, Conn.

Specialists in production threading tools since 1895

PROMPT · · · COMPLETE SERVICE

ON MAGNETIC CHUCKS from WALKER



No. 617 Bar Pole Rectangular Magnetic Chuck.

If you need magnetic chucks of any size or type quickly—get in touch with Walker.

Not only is the Walker line complete, but many standard units are stocked for immediate shipment. Rectangular and Vertical Face types are available for all American-built surface and heavy duty grinders, as well as Rotary Types for internal and surface grinding. The Walker line also includes magnetic chucks for milling, turning and planing.

You'll find the chuck you need described in the Walker Catalog W4. Should you require special designs, outline your needs and ask Walker to quote. Our prices for "specials" are very little more than for standard units.

Style B Face Plate—in standard diameters from 10⅜" to 36½ inclusive.

DEMAGNETIZERS

Walker offers these units in standard D.C. and A.C. types for 110 or 220 V. Bulletin K7, giving details on Walker Demagnetizers, is yours for the asking.

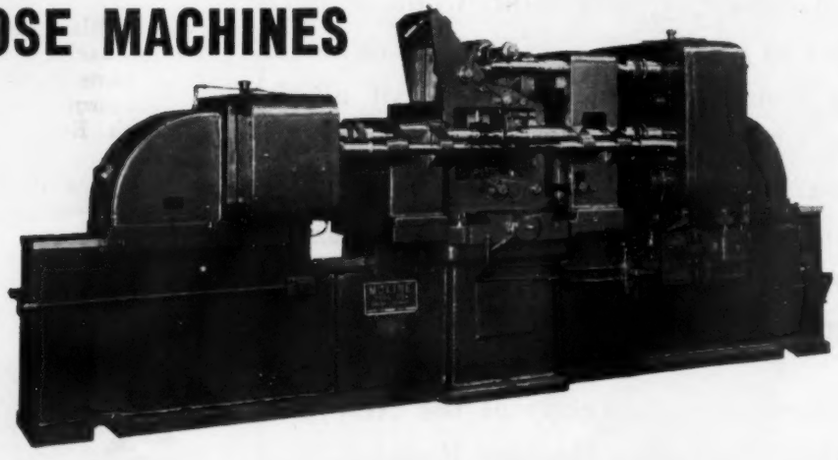
O. S. WALKER COMPANY INC.

WORCESTER, MASS.

SPECIAL PURPOSE MACHINES GET RESULTS

★

This MR-102 Double End, Horizontal, Hydraulic Feed Machine drills and reams rod holes in addition to rough, semi-finish and finish boring, chamfering, counterboring and facing all bearing holes in a tractor steering gear housing.



And by "results" we mean smooth-running production lines and large numbers of duplicate machined parts with a minimum expenditure of time and effort. The special purpose machine pictured here is representative of the line of machines formerly built by Rockford Drilling Machine Co., which is now built by Moline.

Boring • Honing • Drilling • Tapping • Special Machinery

MOLINE TOOL COMPANY

MOLINE, ILLINOIS *Cable Address "Holehog" Moline* **ESTABLISHED 1901**

Atlas 7 INCH SHAPER

Booth 360

4 SPEEDS

•

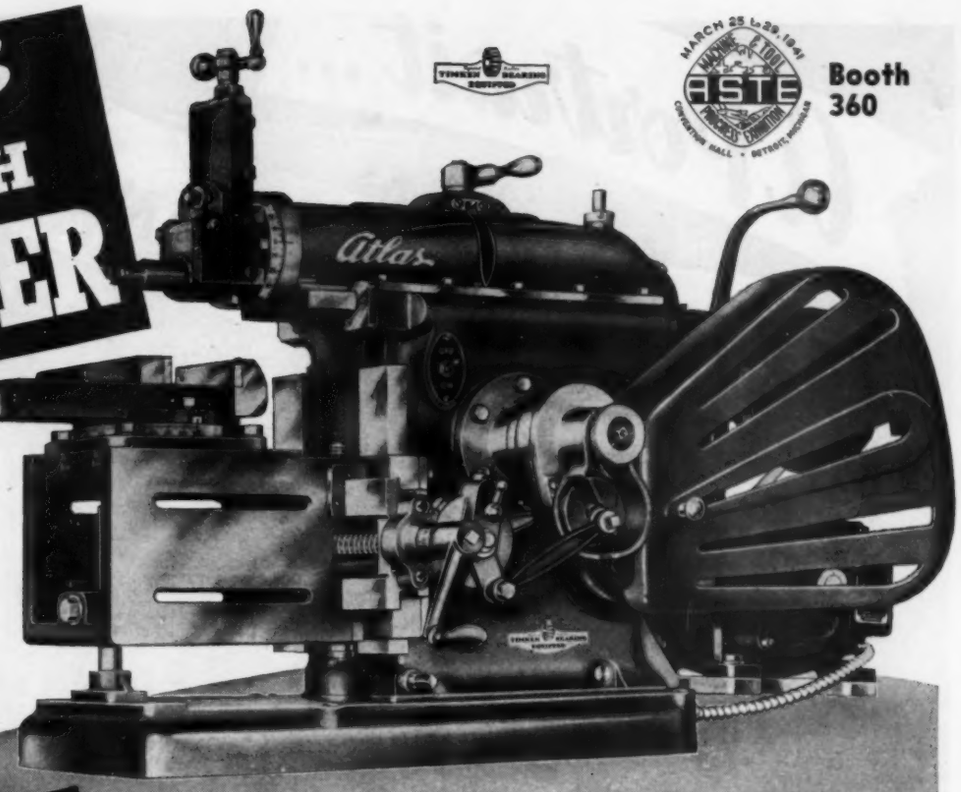
AUTOMATIC CROSS FEEDS

•

COMPLETE V-BELT DRIVE

•

CRANK-TYPE BULL-GEAR DRIVE



TWO OTHER TIMELY Atlas TOOLS

MULTIPLE SPINDLE DRILLING MACHINES

2, 3, and 4 spindles — SKF 4-bearing "Floating Spindle" heads — new head control mechanism — massive ground tables — are features that make these new machines quickly pay their way on drilling and tapping operations. $195, $310, $350 with floor legs less motors (1/3 or 1/2 HP).

LATHES

The modern, economical way to step up production on small-part operations is with an Atlas Lathe. Power cross feed is standard equipment on the F-Series 10" models — plus all other modern lathe features. Prices are as low as $107 for 36" bed. Atlas 6" Lathes — 12" and 18" between centers — are $66.50 and 68.50 less motor.

Handles Small Jobs Easier, Quicker, and Most Economically

Now that Atlas has developed accurate, ruggedly built machines for all types of machining on small parts (lathes, millers, shapers, drill presses) the larger machines can be kept steadily on big work. Result: speedier production and lower costs.

This is a fine example of Atlas-engineered economy — the compact Atlas Shaper, handling everything from ½" to 7" stroke with speed and precision. Hundreds of tool room and shop superintendents can tell you about their cost-cutting successes with Atlas Shapers on the job.

Condensed Specifications: crank-type bull-gear drive, Timken tapered roller bearings, complete V-belt drive. There are 4 speeds — 45, 78, 122, 200 strokes per minute, cutting speeds from 3½" to 116 feet per minute, 5 automatic cross feeds. Horizontal table travel is 9⅜", maximum distance table to ram 5½". Overall dimensions 36" x 17" x 26" high. Operates from ½ HP motor. Price $265 less motor.

Ask your machine tool dealer and send for the new 1941 Atlas catalog for complete details.

ATLAS PRESS COMPANY

304 NORTH PITCHER STREET, KALAMAZOO, MICHIGAN

NEW YORK	CHICAGO	PHILADELPHIA
130 W. 42nd St.	35 E. Wacker at Wabash	113 N. Third St.

QUALITY SHOP EQUIPMENT SINCE 1911

A Portrait... OF TWO MACHINES!

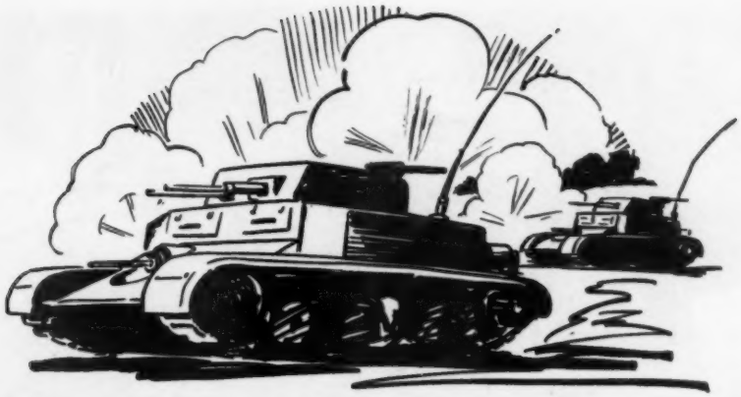
It's true! The Gorton Duplicator, for the reproduction of all types of dies and molds, is in reality two machines. The removal of the duplicator table — a moment's work — converts the Duplicator into a high speed vertical milling machine for the tool room or for light production work.

For full information write today for Bulletin 1319-B.

REG. U.S. PAT. OFF. TRADE MARK
GORTON
RACINE, WIS., U.S.A.

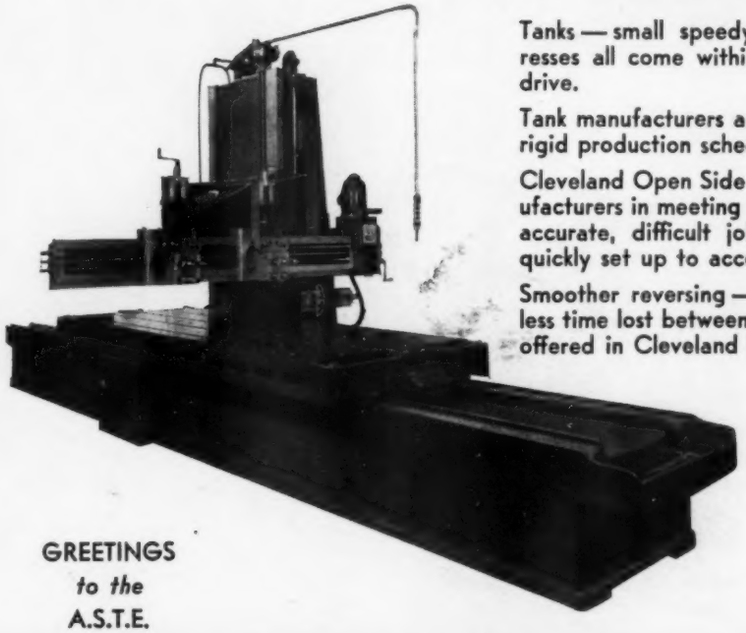
GEORGE GORTON MACHINE CO.

1315 RACINE STREET, RACINE, WISCONSIN, U. S. A.



CLEVELAND *Open Side* PLANERS

MAKE DIRECT HIT WITH TANK MANUFACTURERS IN NATIONAL DEFENSE *DRIVE*



Tanks — small speedy advance units — huge mobile fortresses all come within the range of the National Defense drive.

Tank manufacturers are being seriously pressed to meet the rigid production schedules set up by the government.

Cleveland Open Side Planers are not only aiding these manufacturers in meeting urgent time schedules but in producing accurate, difficult jobs on machines that are easily and quickly set up to accommodate a wide diversity of work.

Smoother reversing — faster cutting and return speeds — less time lost between cuts are only a few of the advantages offered in Cleveland Planers.

Write for detailed information

GREETINGS *to the* A.S.T.E.

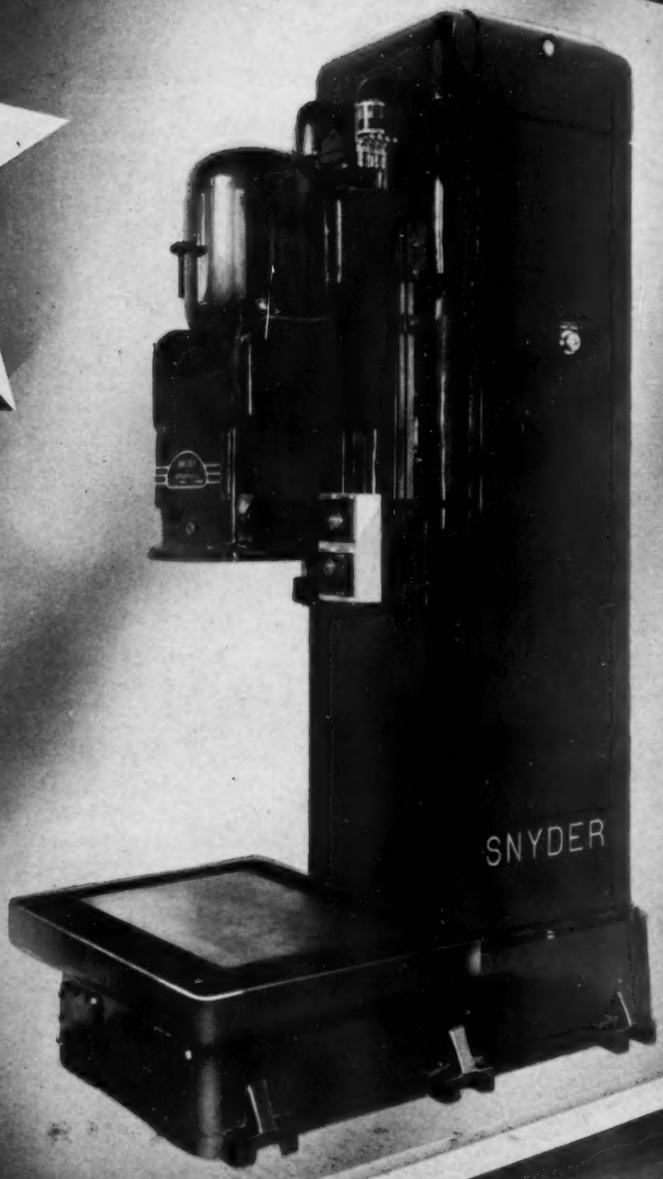
THE CLEVELAND PLANER COMPANY

Open Side Planers Exclusively Since 1900

3148 SUPERIOR AVE., CLEVELAND, OHIO

PRE

A NEW DRILLING MACHINE



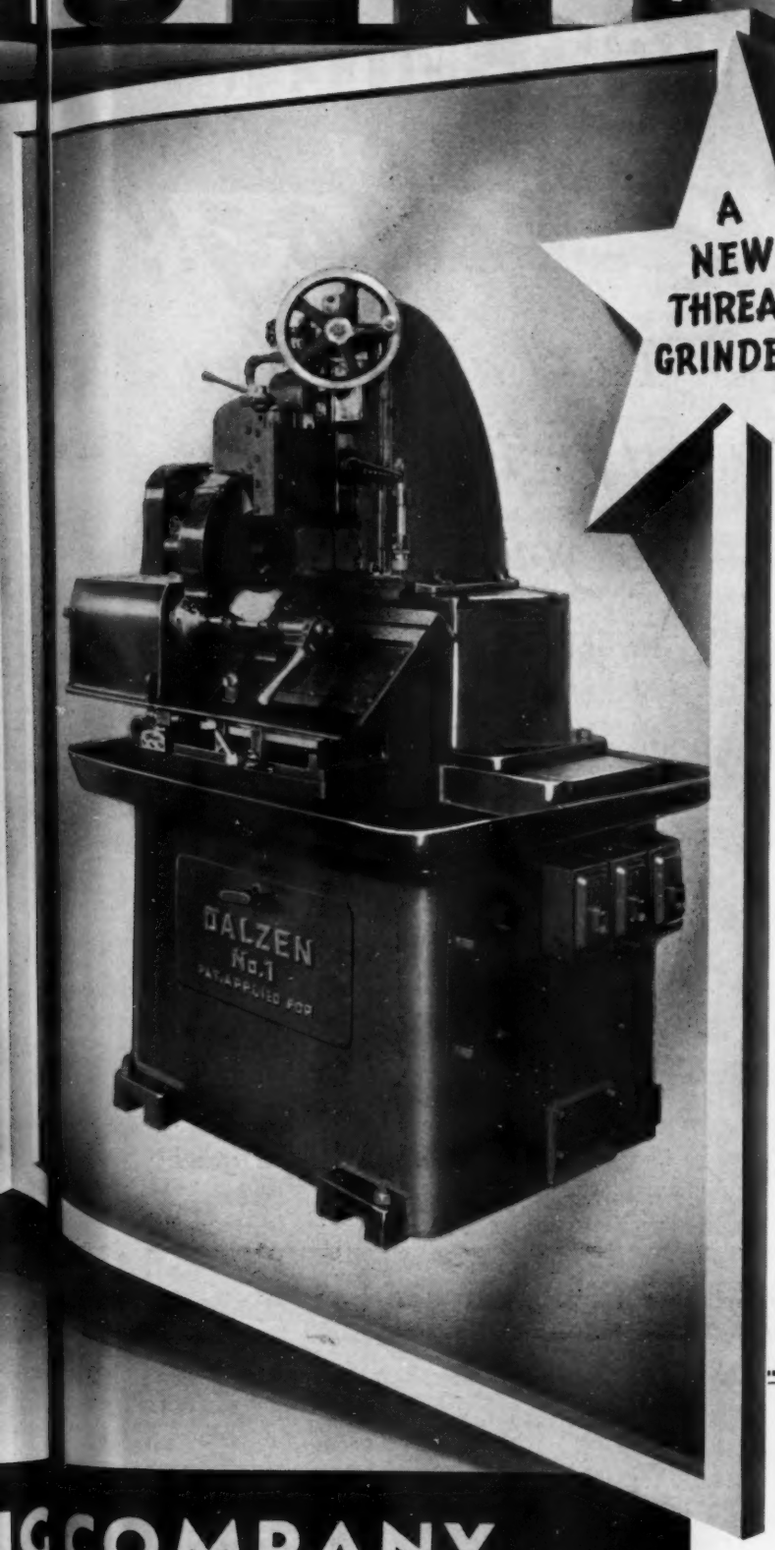
★ Right—New Snyder Drilling Machine, for single spindle work or multi-spindle heads. Adjustable hydraulic feed with rapid advance and return under preset remote control. Note adjustable dogs for controlling cycles, readily accessible on platen above control buttons. Large size for drilling holes up to 5 in.; smaller size for holes up to 4 in.

★ Far right—New Dalzen thread grinder, built by Snyder, for taps, gages, aircraft studs and bolts in U. S., Whitworth and special thread forms. Capacity up to 6 in. diameter, 18 in. between centers, 10 in. length of thread. Smaller size also available.

SNYDER TOOL and ENGINEERING CO

3400 E. LAFAYETTE ST. DETROIT MICH

SENTING



A NEW THREAD GRINDER

...TWO NEW STARS

IN A PREMIER PERFORMANCE—
A.S.T.E. SHOW—BOOTH NO. 131
DETROIT MARCH 25 TO 29

● Don't fail to visit the SNYDER exhibit while attending the A.S.T.E. Show . . . there you'll see the first public showing of two new, outstanding units that are destined to make notable strides in the further reduction of thread grinding and drilling costs.

Every design feature of these units has been proven practical . . . each process in their manufacture is markedly superior . . . strenuous tests in our own plant have shown each separate machine to be highly efficient.

So, make the first move towards lowering your production costs by making it a point to "SEE SNYDER AT DETROIT"—BOOTH NO. 131 A.S.T.E. SHOW—MARCH 25 TO 29.

●

If you can't make the show, you can still get information on these new units—mail the coupon below today.

SNYDER TOOL & ENGINEERING CO.
3400 E. Lafayette St., Detroit, Mich.

Please send me details on your new Dalzen Thread Grinder ....., Drilling Machine .....

Name .....

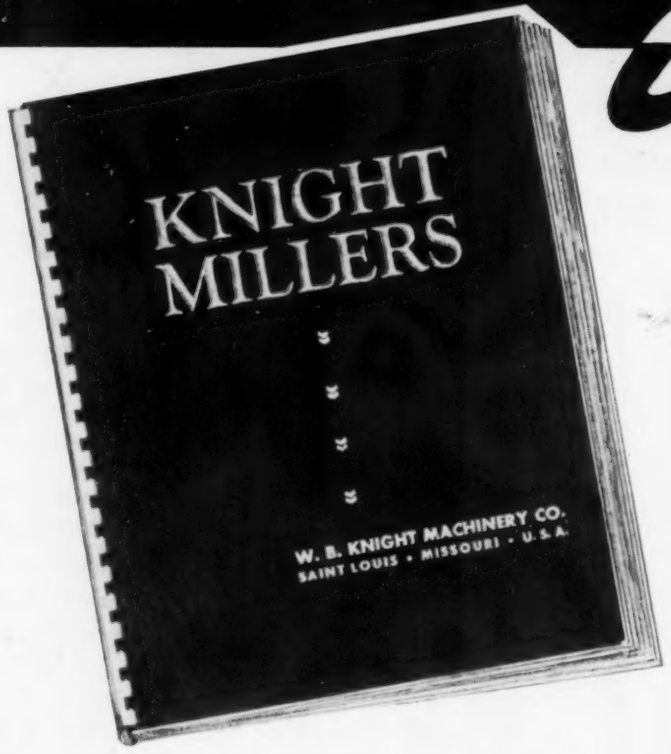
Company .....

Address .....

City ..... State .....

G COMPANY
OIT MICHIGAN, U. S. A.

Send for your Copy of the NEW KNIGHT-MILLER *Catalog!!*



Read about design that is important to you now

IN GETTING GREATER SPEED
IN REALIZING GREATER ACCURACY
IN SIMPLIFYING OPERATIONS

This catalog has just been prepared to fully cover the performance advantages and production benefits of the KNIGHT-MILLER. It points out how you can be dependably equipped to meet the milling needs of such important work as in National Defense requirements. You find out too that with a KNIGHT-MILLER you have the speed to keep up with normal production, get accuracy, and earn a good profit.

KNIGHT VERSATILE MILLERS ACCURATE RIGID

Send **NOW**

- Greater speed in turning out higher quality work.
- Quickly and accurately machine difficult parts without special equipment.
- Time savings by getting adjustments easily and conveniently.

W. B. KNIGHT MACHINERY CO.
St. Louis, Missouri

Please send me free copy of your latest catalog

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firm .....
(firm name must be given)

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W. B. KNIGHT MACHINERY CO.
• ST. LOUIS, MISSOURI •

Building *Hy-Draulic* Machine Tools

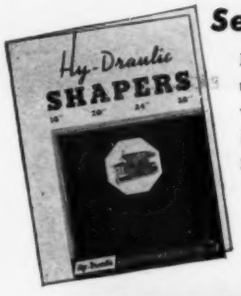
. . . As Fast As It Can Be Done Right

More *Hy-Draulic* Shapers Ready To Step Out

As you read this page, the Hy-Draulic Shapers shown in process below will have been completed and shipped to widely separated tool, die, maintenance and production shops. Others have followed . . . and another lot is ready to step out. At right in the picture are the ends of four 36″ Openside Hy-Draulic Shapers ready for shipment. Elsewhere in our shop are Hy-Draulic Planers, Shaper-Planers, and Slotters . . . all being built as fast as it can be done right.

Hy-Draulic Machine Tools are leaders in their respective fields . . . the *only* tools of their types to provide the pre-eminent advantages of hydraulic drives and hydraulic feeds. They step up production, simplify operation, conserve manpower. Investigate. Write today for details and data.

Hy-Draulic Shaper



Send For This Folder

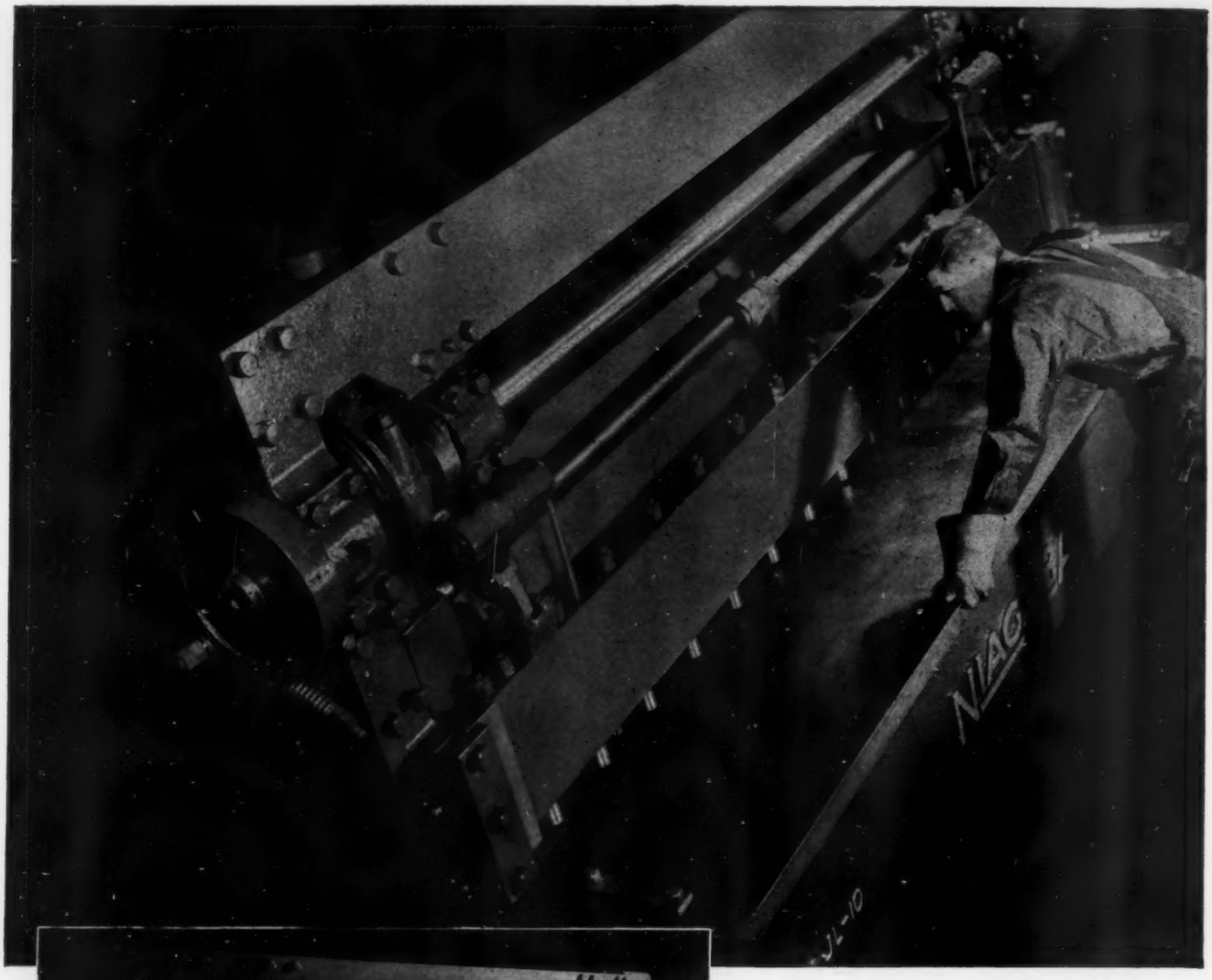
Folder 401 shown at left contains details of Hy-Draulic advantages, data on 16″ to 28″ Hy-Draulic Shapers. Write for your copy, *today.*

Hy-Draulic® Reg. U. S. Pat. Off.

Shapers . . Planers . . Slotters . . Shaper-Planers

ROCKFORD MACHINE TOOL CO.

ROCKFORD, ILLINOIS, U.S.A.



Niagara Power Squaring Shears are built with capacities up to ¾ inch and all cutting lengths. Niagara Machine & Tool Works, 637–697 Northland Ave., Buffalo, N. Y. Branches: Cleveland, Detroit, New York.

These photographs show the latest type Niagara High Production Power Squaring Shears being used for squaring and slitting steel sheets in America's foremost industries including aviation, automotive, electrical equipment plants, steel warehouses, steel mills, railroad shops and other plants. More working strokes per hour are the result of convenient arrangement for handling sheets . . . accessible control . . . instant acting 14-point engagement sleeve clutch with built-in single stroke mechanism . . . smooth acting toggle operated holddown with individual pressure feet for varying lengths of sheets . . . triangular section cross head assuring rigid knife support for accurate cutting . . . clutch and drive gear mounted on anti-friction bearings and enclosed in oiltight case for long life and low maintenance cost . . . new self-measuring ball-bearing parallel back gage providing quick operation and micrometer accuracy.

HPM HYDRAULIC PRESSES for DEFENSE

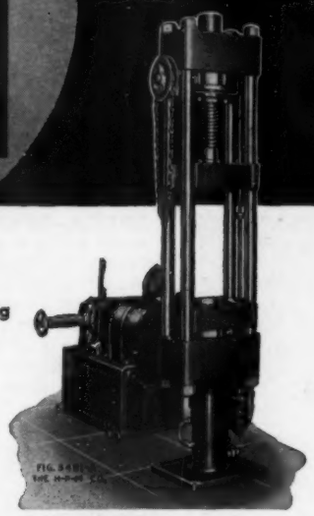


Fig. 5481-A
Projectile Loading

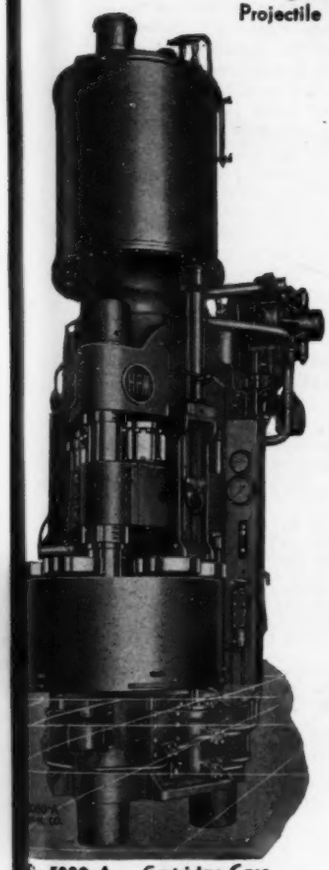


Fig. 5080-A — Cartridge Case
Heading and Indenting

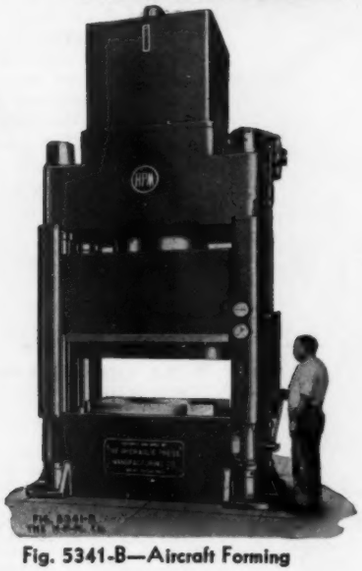


Fig. 5341-B—Aircraft Forming

TEN POINTS TO CONSIDER

1—H-P-M builds a complete line of presses for the defense industries.

2—Presses are self-contained units each with its own pressure generator. H-P-M pioneered the self-contained hydraulic press.

3—Pressure generators employed are radial piston type pumps built by H-P-M.

4—FASTRAVERSE presses employ the H-P-M "Closed Circuit" . . no operating valves . . shockless reversal.

5—Oil is used as a pressure medium . . lubrication is automatic.

6—Press operation is manual, semi-automatic, or full automatic as desired.

7—Only a minimum of floor space is required for press installation.

8—H-P-M assumes full responsibility for successful press operation. All major items designed and built by H-P-M.

9—H-P-M's manufacturing facilities are the most modern in press business.

10—H-P-M's World War experience plus a qualified engineering staff assures a superior product of modern design.

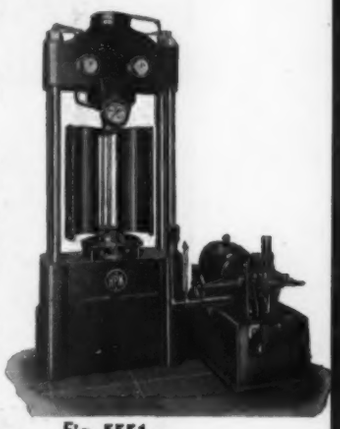


Fig. 5551
Shell Testing

THE HYDRAULIC PRESS MANUFACTURING CO.
MOUNT GILEAD, OHIO, U. S. A.

District Sales Offices: New York, Syracuse, Detroit and Chicago
Representatives: Boston, Worcester, Hartford, Providence, Pittsburgh, Akron, Cleveland, Cincinnati, Flint, Seattle, San Francisco, Los Angeles.
Foreign Representatives: Canada and England.

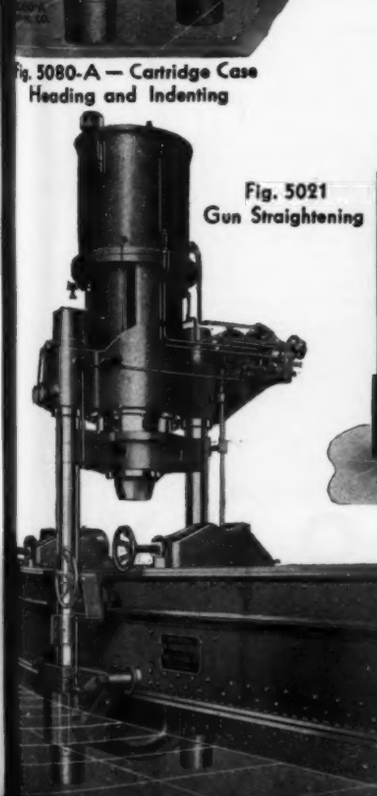


Fig. 5021
Gun Straightening

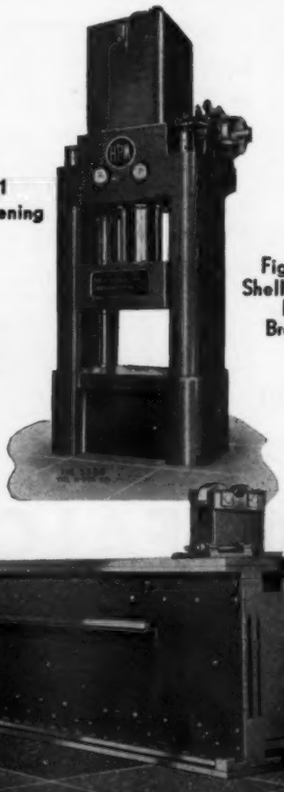


Fig. 5580
Shell Nosing,
Billet
Breaking

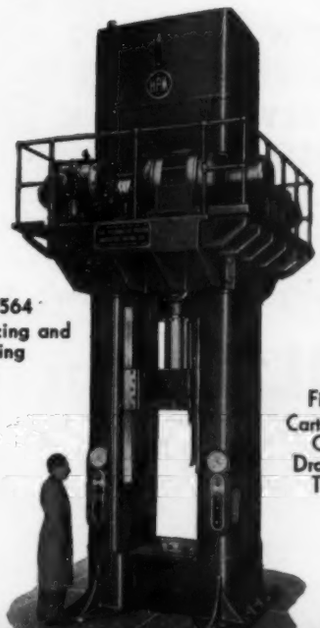


Fig. 5564
Shell Piercing and
Drawing

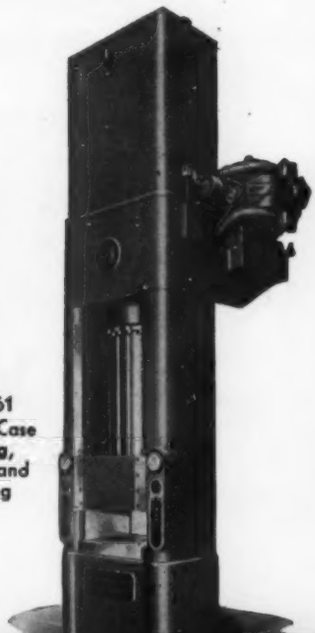
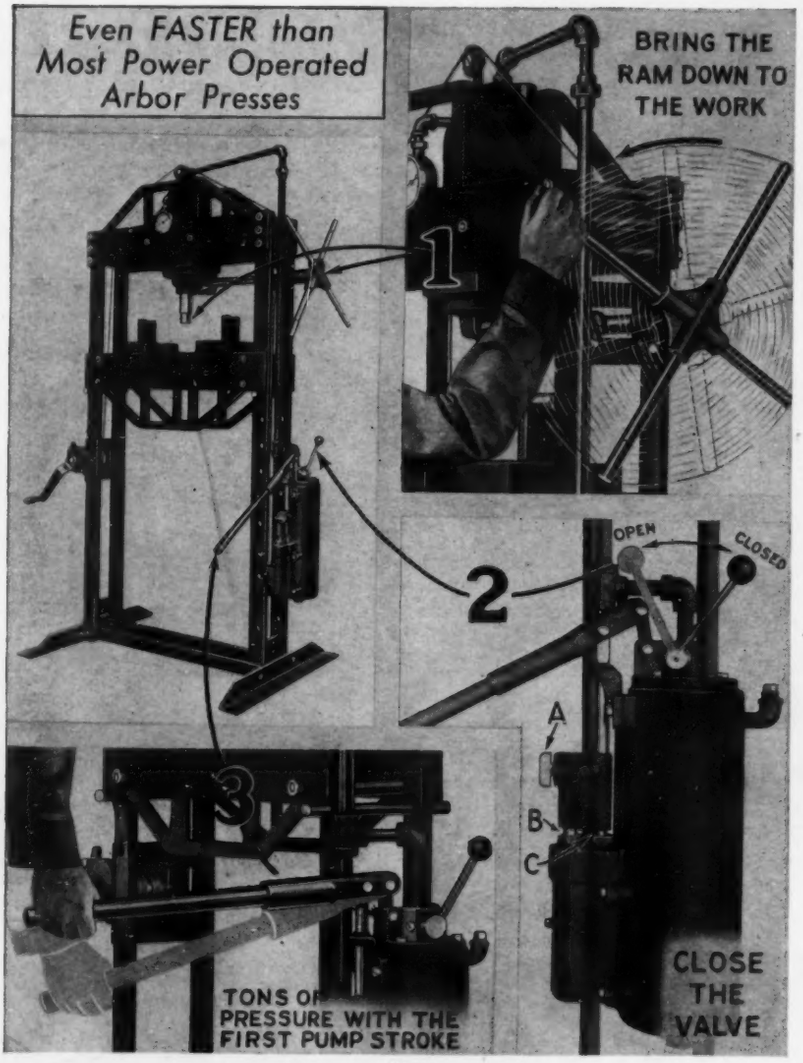


Fig. 5361
Cartridge Case
Cupping,
Drawing and
Tapering

TONS OF PRESSURE "ON THE WORK" IN 3 SECONDS

with KRW HYDRAULIC ARBOR PRESSES!



SPEED—SPEED and MORE SPEED to meet today's production problems! KRW Hand Operated Presses are faster than most power-operated Arbor Presses—FASTER in getting the ram to the work—FASTER in reaching required tonnage pressure and FASTER in raising the ram to remove the work. 3 quick steps of operation. 1. Ram is quickly brought down by rotating the "Capstan" type Hand Wheel. Ram travel is fast because it is mechanical. Slow, laborious, inch by inch hydraulic pumping preliminary to the power stroke is eliminated. 2. Valve is closed by a simple flip of the ball arm, "quicker than you can say Jack Robinson." 3. The first pumping stroke produces tons of ram pressure because the hydraulic cylinder was automatically filled with oil in operation No. 1. A few succeeding strokes build the pressure up to the rated capacity.

But speed of operation is incidental to many other KRW features.

TWO SPEED PUMP—Single plunger action (B) for easy operation at high tonnage pressures. Double plunger action (C) two and one-half times faster for lighter operations. A simple turn of the winged finger lever (A) selects the speed desired.

"SENSITIVE" PRESS—Built in. Rack and pinion operated. Capstan spokes pull out for increased leverage. Result—3 Tons Ram pressure.

TABLE LIFTING DEVICE—"One man" operation. Easily raises or lowers table to eight working positions. In lowest position, work of extreme height can be inserted under ram.

SIDE MEMBERS have openings through which long bars, axles, etc. can be passed. Work of extreme height or length can be accommodated.

V-BLOCKS—Standard equipment—Made of welded steel—machined in matched pairs. Slide accurately on planed edges of table. Can be used as test centers in straightening operations without removing work from the press.

TRUSS REENFORCEMENT of Table and Crown on 50 and 75 ton Presses adds strength and rigidity. Table is supported on heat-treated, alloy steel pins. Holes for pins are machine **drilled** in special jigs, insuring accuracy and alignment of table in any position.

PRESSURE GAUGE reading in pounds and tons pressure is standard equipment on all KRW Presses.

KRW Presses are used in every type of industry, for broaching, assembling, straightening, bending, squeezing, offsetting, pressing, flattening and die testing. Blanking of small parts can be accomplished when dies are built into die sets provided with guide pins. Hardwood dies are used in aircraft plants for forming light metal experimental parts.

Write today for the new KRW Hydraulic Arbor Press Bulletin. It shows "on the job" pictures of the many types of work these presses are doing—better and faster. **Accelerate with KRW Presses!**

No. 37—25 TON KRW HYDRAULIC ARBOR PRESS . . . $180.00

No. 37E—50 TON KRW HYDRAULIC ARBOR PRESS . . . $235.00

No. 37F—75 TON KRW HYDRAULIC ARBOR PRESS . . . $365.00

Above prices F.O.B. Arcade, N. Y.—Slightly higher west of Rockies

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INCREASE PRODUCTION FOR NATIONAL DEFENSE *with* SOUTHWARK SHELL MACHINERY

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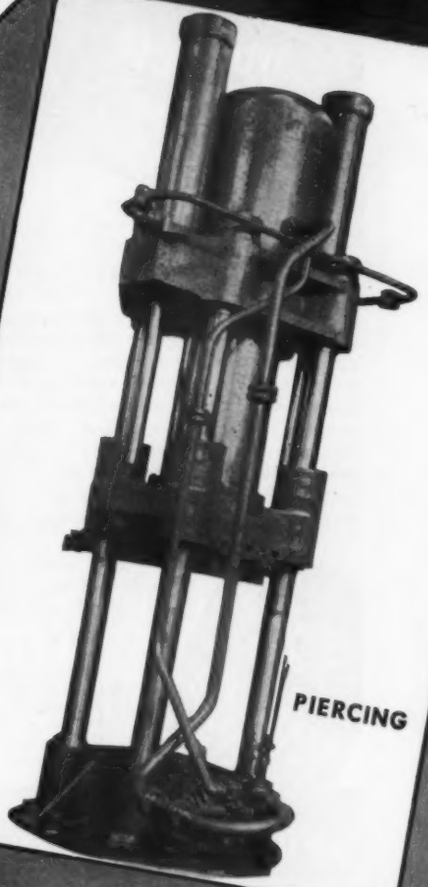
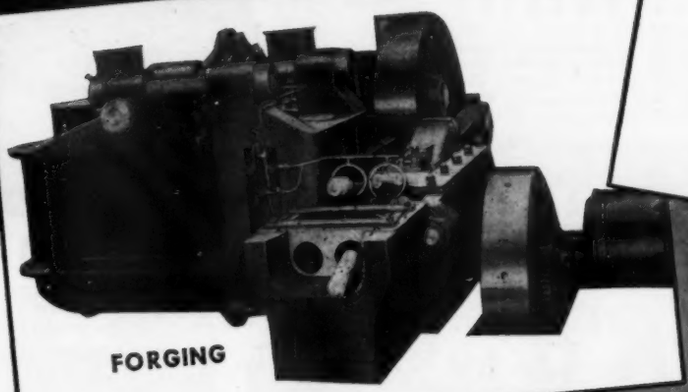


PIERCING

• DOUBLES OUTPUT



FORGING

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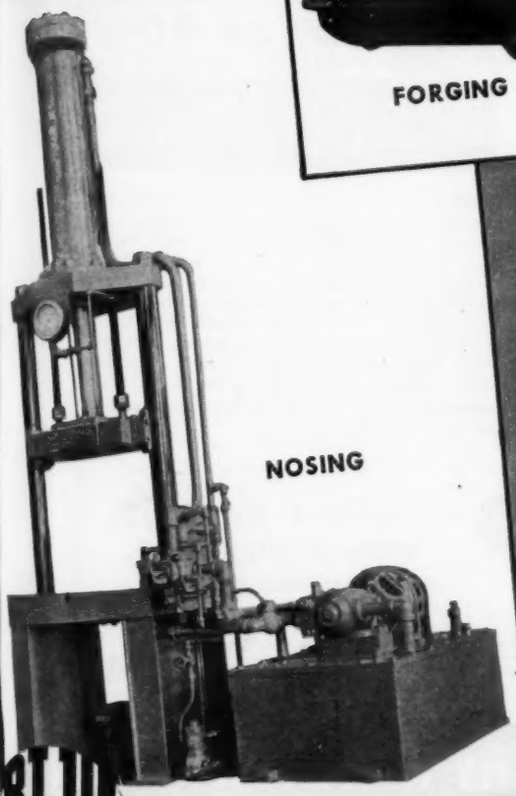

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SOUTHWARK HYDRAULIC SHELL MANUFACTURING MACHINERY

Piercing presses • Ring type drawing presses • Roller type drawing presses • Nosing presses • Hydro-static testing presses • Baldwin-Omes Mechanical Forging presses • Banding presses • Base seating presses • Accumulators • Pumps • Piping • Valves

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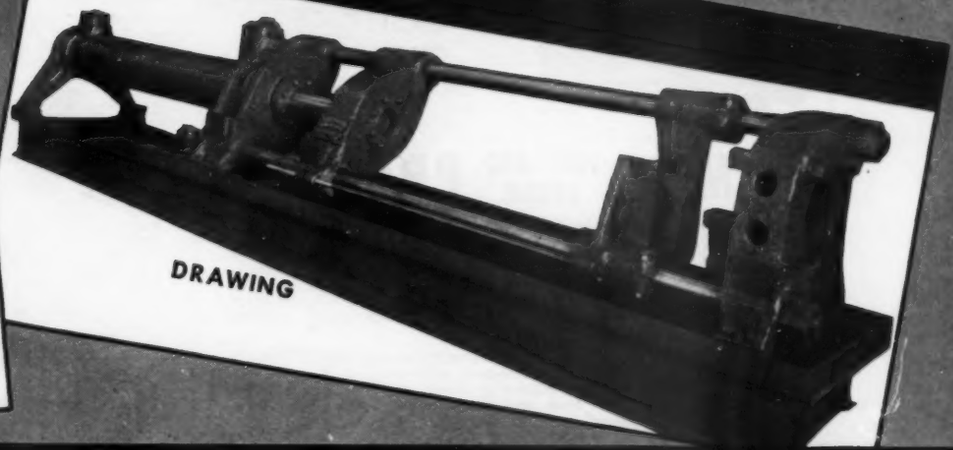

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BALDWIN SOUTHWARK

Division of THE BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA

New HYDRAULIC Knee Type PRESS

for RAPID RETOOLING ON SMALL WORK

5 and 15 TON CAPACITY

This Type DLKC2 Press is one of the line of new, Standard small capacity Denison Hydraulic Presses just announced. Revolutionary in efficiency! Designed especially to facilitate rapid change of tools or fixtures, it's ideally suited for a wide range of high-production or small-lot work. The streamlined frame saves space; is free of projections; and is modern appearing and rugged. Controls are located for safety. Electrically or manually operated. In 5- or 15-ton capacity; strokes of 12 to 30 inches; and maximum vertical opening of 46 inches. It offers a new source of economy in large or small plants. You'll want the details!

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While our standard line of presses are subject to modifications, we also build all types of special hydraulic presses. So when you have a press problem, tell us about it. The Denison Engineering Company, 114 West Chestnut Street, Columbus, Ohio.

Small Capacity

DENISON HYDRAULIC PRESSES

O.K'd by AMERICAN INDUSTRY!

because they handle hundreds of operations

FASTER—
BETTER—
EASIER—
CHEAPER—

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FAMCO FOOT AND ARBOR PRESSES

Hundreds of operations now being performed by hand or makeshift methods can be handled much more efficiently by FAMCO Foot and Arbor Presses. Thousands of manufacturers, representing every line of business, have changed to FAMCO after checking records on production and assembly operations which required pressure or percussion. All FAMCO Arbor Presses—incorporate an exclusive FAMCO feature—the adjustable Gib which assures perfect alignment at all times.

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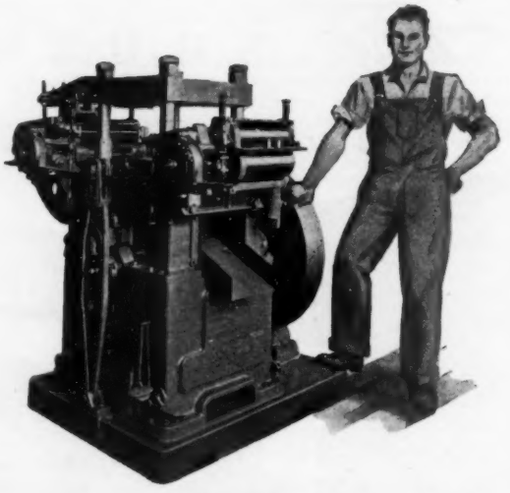
WITH THIS MACHINE, I'M TURNING OUT AS MANY STAMPINGS AS TEN MEN OPERATING TEN CONVENTIONAL PRESSES!



The unique Dieing Machine sets new stamping standards reducing costs 60% to 90%

A variety of machine gun belt links are produced complete one per stroke at rates as high as 140 per minute.

Eyelets of .022" brass produced 5 complete at each stroke at high speed, giving 60,000 completed pieces per hour.

Producing one right hand and one left hand part complete per stroke, 250 of these parts are produced complete per minute.

Producing intricate parts COMPLETE PER STROKE

Producing 1 to 20 completed parts per stroke at speeds up to 600 strokes per minute, one Dieing Machine will equal the production of 5 to 10 conventional presses. Consequent savings often are 60% to 90% of stamping costs, while die life is usually increased 600% to 1200%. Operating with amazing smoothness and precision, the Dieing Machine will consistently produce parts to precision of .0002" when required. Capacities: 10 tons to 300 tons.

Request Catalog 41

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HENRY & WRIGHT DIEING MACHINES

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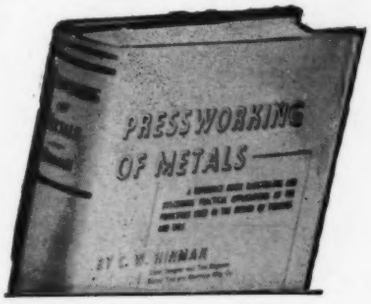

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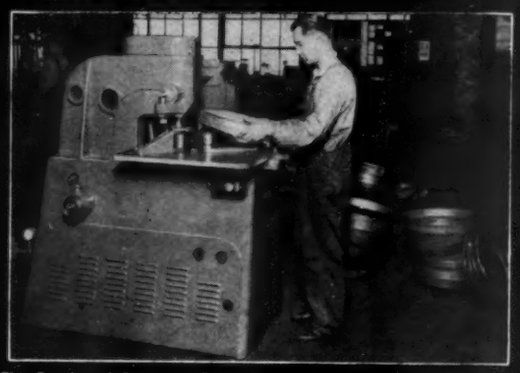
Combination Stamping Trimming and Forming Machines provide an economical method of beading, flanging and forming —in addition to trimming.



This Quickwork Stamping Trimming and Forming Machine is electric eye controlled to automatically open the rolls so that the stamping and scrap can be easily removed from the machine at completion of each cut

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Here's an ETNA Swaging machine in *another* well known plant. This machine is pointing tube for drawing. This method contributes to fast, economical production by giving the tube a smooth, clean and *open* point.

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MACHINE COMPANY
TOLEDO OHIO

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WITH THE No. 3
MOTCH & MERRYWEATHER
COLD SAWING MACHINE

arranged for cutting
Shell Forging Slugs

The product of Motch & Merryweather's 37-year machine tool background. *A few features:* convenient control in front governing feed rates, starting and stopping, and clamping •• nine speeds in geometrical progression from 18 f. p. m. to 134, located at front of carriage •• spur and helical gearing in saw blade drive •• high speed drive shafts mounted on anti-friction bearings •• automatic oiling to saw drive and carriage ways •• twin-disc clutch for starting and stopping independently of motor •• hydraulic low pressure system provides stepless variable feed and quick return •• work held on both sides of saw blade, eliminating burrs •• rigid box-shaped base and massive carriage with ample bed ways. Adjustable stock stop, roller lift, chip wipers. Capacity—8⅝" square, 9⅝" round with 28" blade; 1" more with 30" Ideal for cutting shell forgings, slugs and like tough jobs. Write for new Bulletin "A."

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. . . I WANT TOP SPEED PLUS ACCURACY ON EVERY METAL SAWING JOB

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"DOES ALL THAT IS CLAIMED FOR IT"

SAYS A LARGE MANUFACTURER . . . . .

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—that's what we claim and we are proving our claims in one installation after the other in services ranging from general shop work to full automatic operation.

The No. 30C Racine 10x10 Hydraulic Feed illustrated is used to saw hot and cold rolled round stock. The automatic quick acting hydraulic chucks, both side clamping and overhead clamping, securely hold nested stock and prevent bars from chattering or working loose. Smooth, oil-cushioned hydraulic power easily moves ahead such heavy loads as the one illustrated and accurately guages them for each cut. Automatic gauging is done hydraulically at the side of the machine with the front left clear for easiest handling of stock.

Hydraulic Feeds and Controls give smooth, quiet performance and the correct speeds for cutting all types of steel. Automatic continuous production saves 80% of operator's time.

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ATKINS PUTS TEETH *In the Defense Program!*

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● Tools play an indispensable part in National Re-Armament—as vital as the ships and shells, the trucks and tanks, barracks and bridges, grenades and guns they *make possible*. And the basic tools are still those which cut—the knife, and that *multiple knife*, the *saw*. Most jobs begin with cutting off material to be used, and nearly all jobs at some stage employ cutting, shaving, grinding.

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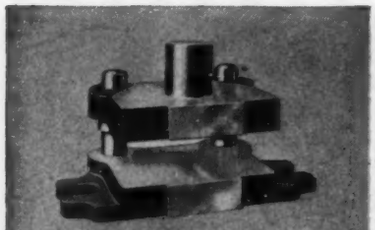
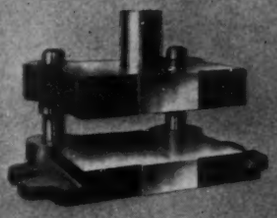
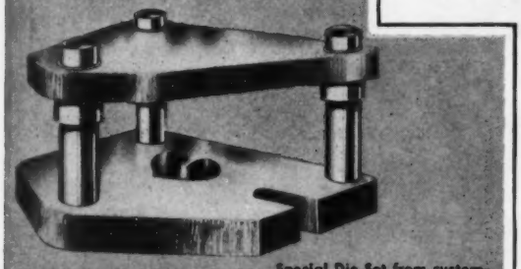


Style 140 Series — Standard 2 pin



Standard Die Set with steel base



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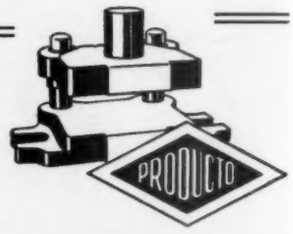

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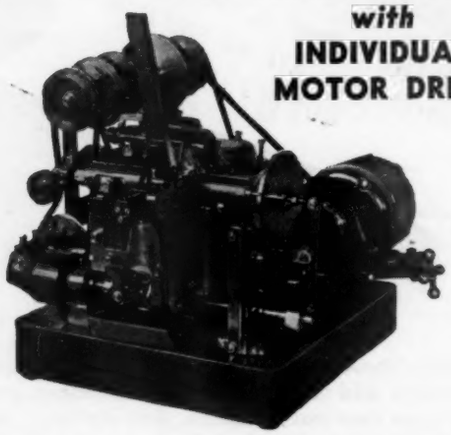

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Great Accuracy
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Production. . . .

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The magazine feed may be omitted and fine pitch gears up to 1½" diameter may be cut in a stack about 1" long.

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HIGH SPEED

TWIST DRILLS

ONE OF THE FINEST

POLISHED FLUTES

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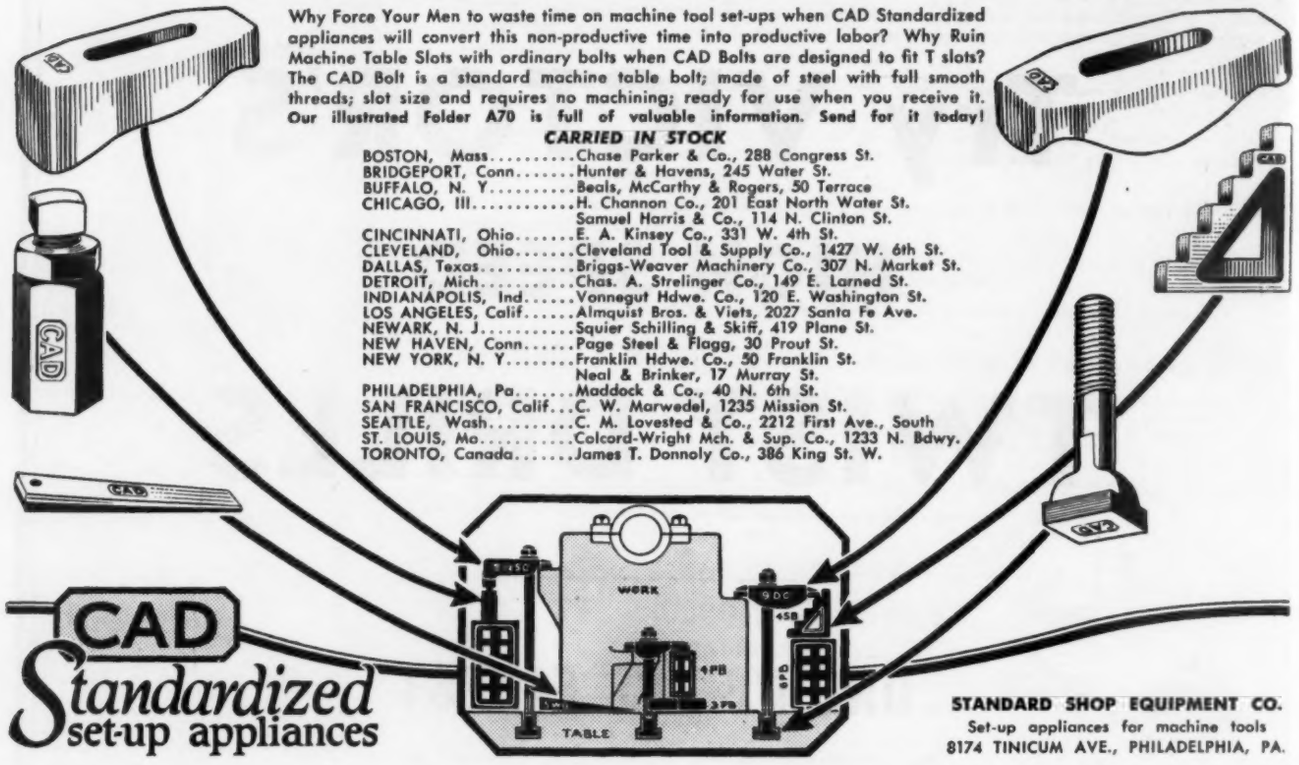

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Set-up appliances for machine tools
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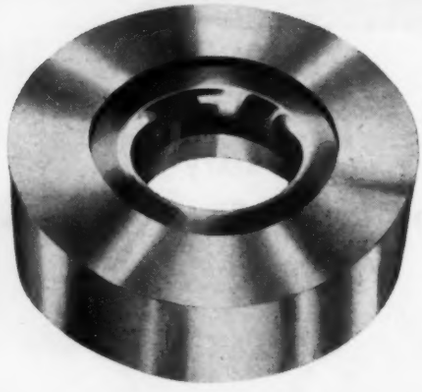

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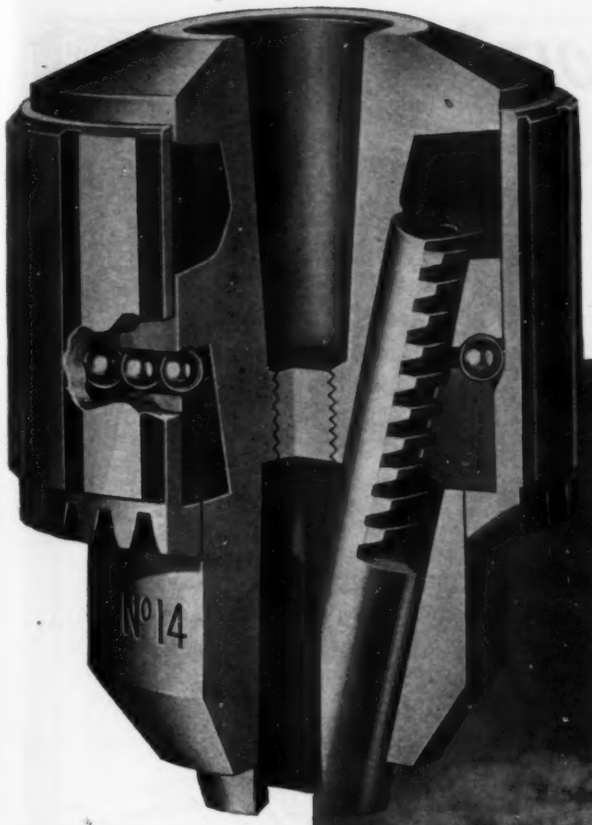

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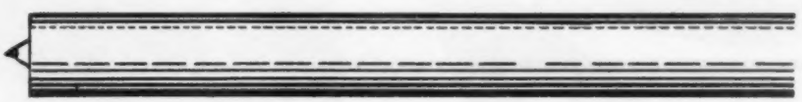

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Knife	Finishing
Warding	Taper Saw
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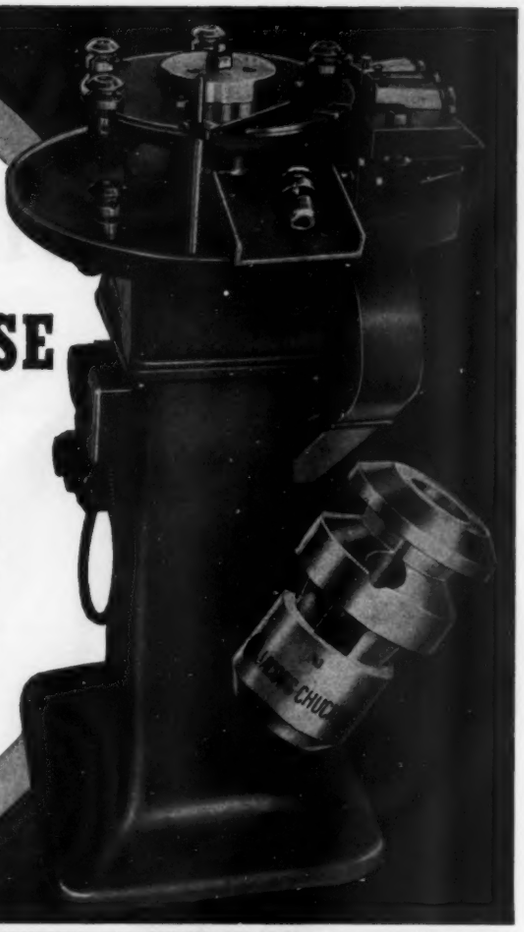

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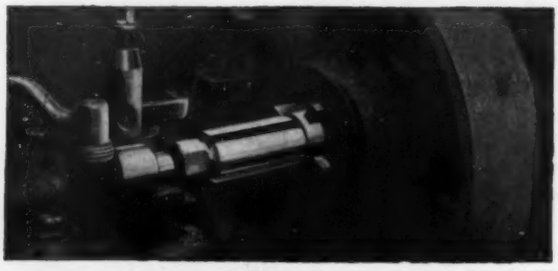


TYPE B

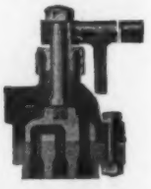
Standard design made in 14 sizes, range 1/2" to 7" bores, including fractional sizes.

Economy tools called Nicholson Expanding Mandrels, but in reality internal chucks for holding miscellaneous jobs on lathes, grinders, millers, shapers, etc. while being machined.

TYPE A

Step Jaw Design made in 4 sizes—Ranges taken by size 1A—1/2" to 1", 2A—1" to 1 1/2", 3A—1 1/2" to 2", 4A—2" to 3", 5A—3" to 4", including all fractional sizes.

STYLE E



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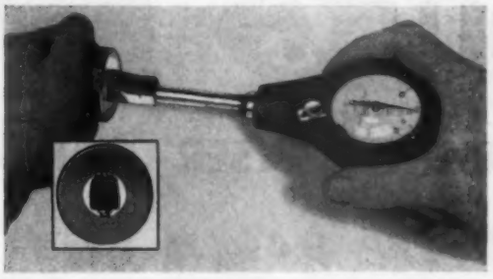

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These gages *"repeat"* and they are sensitive. They "repeat" more faithfully than you have yet experienced. The movement of the contact point is transferred directly to the Indicator without bearing or bushing friction, and without "sloppy" motion. There's nothing like them for checking holes.

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Direct diameter readings are taken centrally across the hole.

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Any hole from .750" up to 8" and larger, and holes of any length can be checked more positively with these gages than anything you have seen. If you have to finish rifle and gun bores ask about our gun bore gage, it checks the "lands" and "grooves" following the spiral smoothly, and it checks accurately. Best of all it tells the true facts every time — it "repeats" faithfully.

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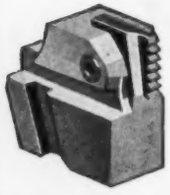

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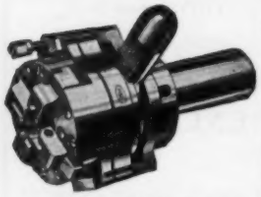

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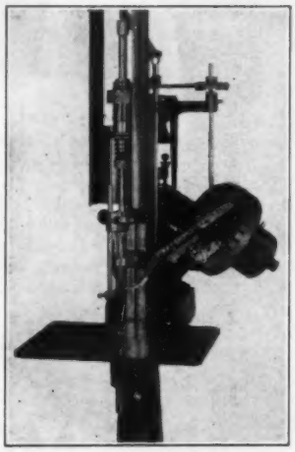

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No production bottleneck

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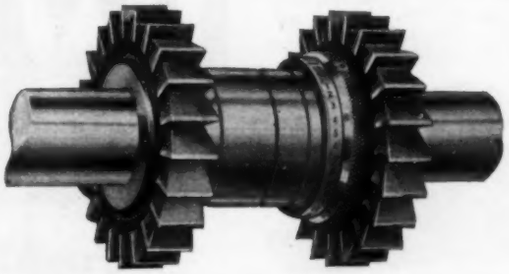

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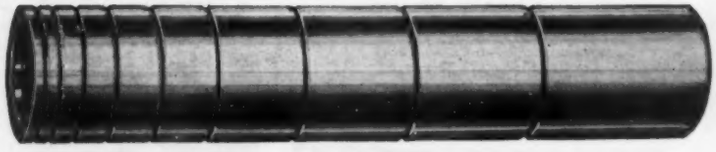

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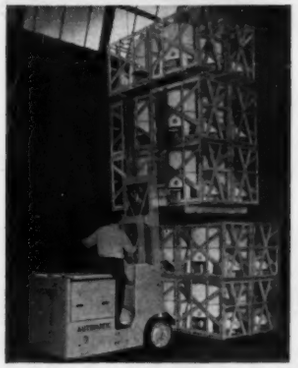

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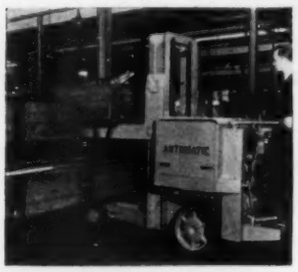
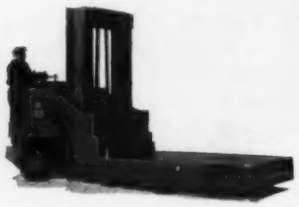


Model "TLN-3"—For 6000-lb. skidload tiering plus transportation. Has standard platform 55" long, 27" wide, 10¾" high, 60" lift.



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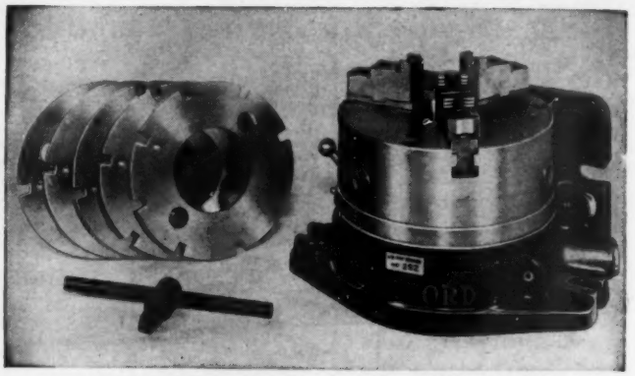

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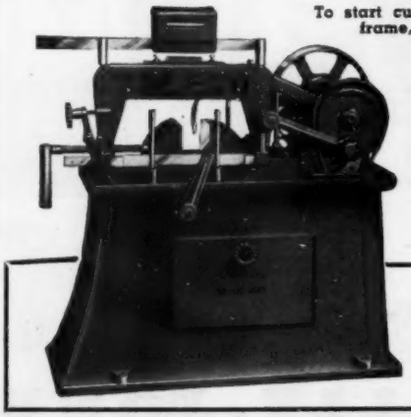

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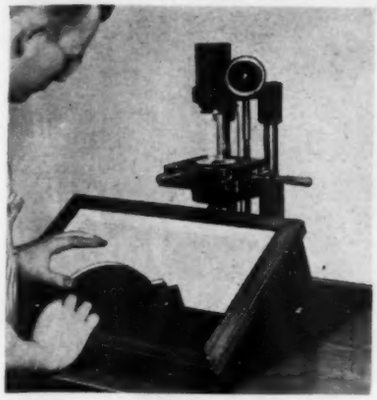

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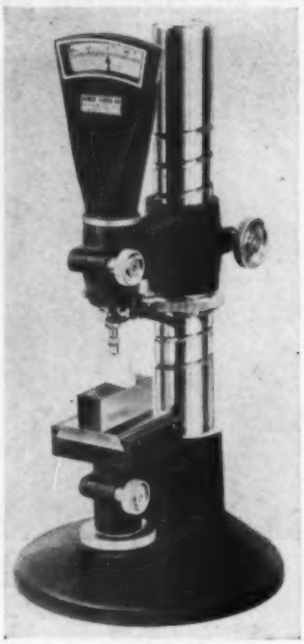

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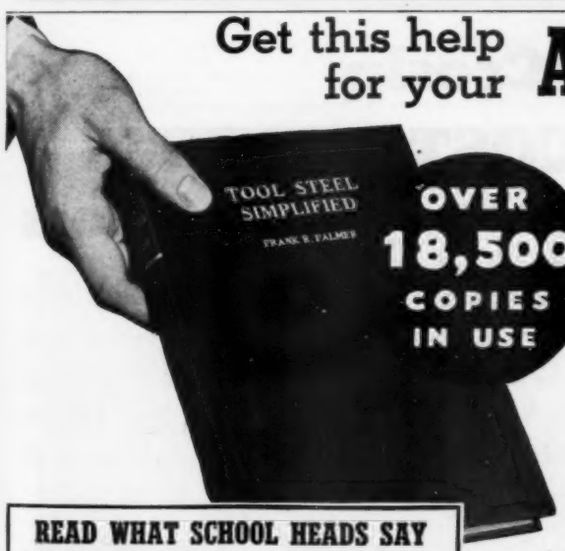

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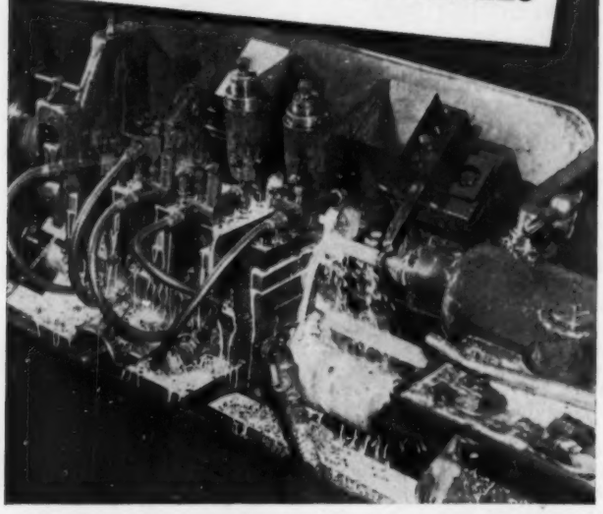

Roughing operation on a Garand rifle barrel, using KENNAMETAL-tipped tools in a Fay automatic lathe.

with KENNAMETAL Turning Tools

One of the first operations in making the new Garand rifle is rough turning the caliber .30 rifle barrels. A high, uniform rate of production must be maintained at this point to insure an ample supply of machined barrels for subsequent operations.

Style No. 11 KENNAMETAL tool similar to the tools used to rough turn Garand rifle barrels at Springfield Armory.

The modern U. S. Armory at Springfield, Mass., uses five KENNAMETAL KM tools in Fay automatic lathes in the first rough turning operation, which takes cuts on the muzzle end. Two additional carbide-tipped tools are used at the back for facing a shoulder and chamfering the muzzle. Although the barrels are made from chromium-molybdenum steel (SAE 4150) heat-treated to 269-311 Brinell hardness, the KENNAMETAL tools take the cut at 200 ft. per min. Feed is .008" per revolution and depth of cut is ¼" on a side. Tools are ground every 200 pieces, and average 12 regrinds per tool or at least 2400 pieces per set.

KENNAMETAL KM tools are also used at Springfield Armory to finish the barrel on the taper section, and solid bars of KENNAMETAL K3H are used for precision boring of chamber in the breech of the gun. Use of KENNAMETAL on these operations permits close tolerances with a smooth finish and assures uniform results.

See Our Exhibit at BOOTH 345 A. S. T. M. Show

You are cordially invited to attend the KENNAMETAL exhibit at Booth 345, Machine & Tool Progress Exhibition, Detroit, March 25-29.

Whether you are engaged in defense production or in the manufacture of articles for commercial use, you can speed up production with KENNAMETAL, the *reliable* steel-cutting carbide tool material.

Write for complete information today.

McKENNA METALS Co
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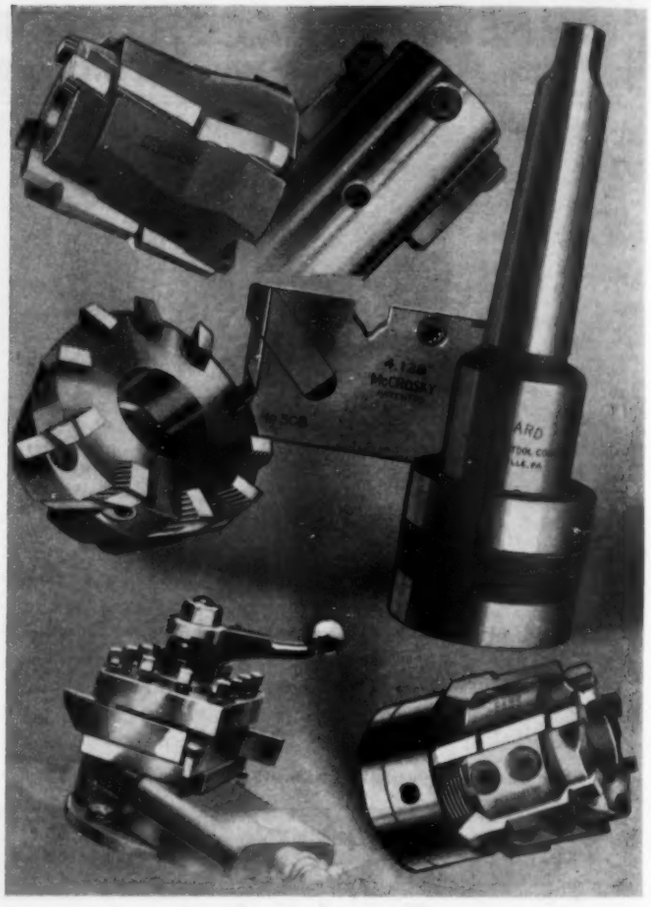
LATROBE, PENNSYLVANIA, U.S.A.



McCrosky COST CUTTING Tools

● For a complete display of standard and special McCrosky inserted-blade tools, and of McCrosky tool-holding devices that save time, visit the McCrosky Booth No. 146 at the 1941 ASTE Exhibition, Detroit, March 25 to 29

● For your reference file send for separate descriptive bulletins on the McCrosky Tools listed below

McCROSKY TOOL CORPORATION
MEADVILLE PENNSYLVANIA
COST CUTTING TOOLS

SUPER ADJUSTABLE REAMERS
JACK-LOCK MILLING CUTTERS
WIZARD QUICK-CHANGE CHUCKS
ADJUSTABLE BLOCK BORING BARS
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McCROSKY TURRET TOOL POSTS

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Write for our complete list of modern equipment and see why we can give you low prices, speedy delivery and quality work on Designing and Building of Special Machinery, Tools, Dies, etc. Send blueprints or samples for price estimates.

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MAKING TOOLS—JIGS
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Large plant—can produce large or small quantities—accuracy guaranteed.

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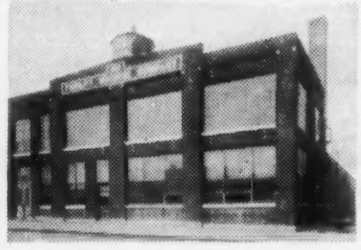

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Use our facilities to boost your production! Drawing and stamping dies, stampings, special machinery our specialties. Send blueprints or samples for prompt quotation.

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Has facilities to make small machine parts. Precision work. Mail prints for prompt quotation.

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WILLIAMS IRON WORKS, INC.
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Precision Boring Machine
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Adaptable for fast, accurate work with 1, 2, or 3 boring units.

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Use our plant as your branch factory! Production machine and finishing work can be handled quickly and economically by experienced machinists. Factory facilities for:

Light milling, press, and drill press jobs
Hardening and tempering, Polishing and buffing, Chrome and nickel plating

Long experience with hardening and grinding tool steel makes any type machine knives of moderate size a specialty. Also facilities for small forgings. Write today for prompt estimate! Send samples or blueprint if possible.

"SHEARER MADE IS WELL MADE"

AMERICAN SHEARER Mfg. Co.
Established 1865
NASHUA NEW HAMPSHIRE

DIES, TOOLS
SPECIAL MACHINERY MANUFACTURERS

Send us your blueprints for estimate

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Is the Contract Work Section helping *American Machinist's* subscribers and readers find outside help when they need it? Does advertising in this section really do its job?

If you have idle equipment to put to work, you will want the answers to these questions. You can get them quickly by addressing CONTRACT WORK DEPARTMENT, *American Machinist*, 330 West 42d St., New York, N. Y.

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Quick action on your problem! Use our manufacturing facilities as your branch factory. Well-equipped for small and medium-sized work. Investigate time-saving possibilities *today!* Send prints or samples.

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STAMPINGS
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MOLDED PARTS
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• TOOLS • DIES •
Heat Treating • Permanent Magnets
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SMALL STAMPINGS
of all kinds, plain and formed.
Not over 35 ton press capacity
We specialize in textile stampings
Let us quote you prices
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LIGHT
METAL STAMPINGS
Our facilities, plus our experience and ability, guarantees turning out your job **exactly as ordered.** Send us your Blue Prints for quotations on your next job.
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SMALL DIES AND STAMPINGS
Progressive Blanking & Forming Dies
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SPECIAL ENGINEERING WORK
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A. H. NILSON MACHINE COMPANY, BRIDGEPORT, CONN.
designers and builders of wire and ribbon stock forming machines.
We also solicit your bids for cam milling

ELIMINATE COSTLY FORGINGS . . . CASTINGS . . . RIVETED ASSEMBLIES with ECONOMICAL, EFFICIENT
ELECTRIC FURNACE BRAZING

These are MEPCO Copper-Brazed assemblies of inexpensively produced simple parts. They are equal to parts produced from the solid! Cost and time savings are obvious.

A difficult one-piece job is often ridiculously easy when made of two or more pieces, and furnace brazed.

Electric Furnace Brazing is extensively used on a wide range of products in different metals . . . especially on assemblies of Tubing, Stampings and Screw-Machine Parts—in unlimited combinations.

Copper-Brazed Steel Parts are actually clean enough to be electro-plated without pickling—that's CLEAN!

Our Service includes batch or continuous furnace-brazing of your parts, sent to us for processing.

We can supply Sub-Assemblies, fabricated and brazed to your specifications.

TELL US YOUR PROBLEM, AND LET US SEND YOU SAMPLES AND PRICES—SHOWING HOW *WELL* AND *CHEAPLY* WE CAN DO IT!

THE METAL ELECTRIC PROCESSING CO.
1927 Nebraska Ave. Toledo, Ohio

HYDROGEN BRAZING
We are equipped to furnace braze your production runs of small parts.
We can also handle some precision screw machine work.
Excel contact points.
A. H. HYNDMAN CO., INC.
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BONIS
Die Coating—Mold Dressing For All Non-ferrous Die and Permanent Mold Castings.
Write For Circular and Prices.
ST. JOHN X-RAY SERVICE, INC.
LONG ISLAND CITY, NEW YORK

GRAY IRON — ALLOY — SEMI STEEL
CASTINGS
From 15 to 15,000 lbs. • Rough or Machined
General Machine Work
AJAX IRON WORKS
CORRY, PENNSYLVANIA

M A C H I N E D
GREY IRON CASTINGS
Up to 60,000 P. S. I. Tensile Strength
and kindred items effectively produced in small quantities—Individual parts to 2,000 pounds—Assemblies to 5,000 pounds.
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Accurate, dependable service. Patterns for cast gears a specialty. Send prints for quotation!
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We are equipped to serve you better
•
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PATTERNS in WOOD and METAL
For All Kinds of Castings, Large or Small
MATCH PLATE WORK A SPECIALTY
Put your pattern problems up to us—we will take care of them—ask the foundries about our work—they use our patterns every day.
GENERAL PATTERN WORKS
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GREIST PRODUCTS
When you need complete small assemblies, call on Greist! They're our specialty. Quotation furnished promptly on
Screw Machine Products
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Tools, Dies, Jigs, Fixtures
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Quality work by skilled mechanics is assured. Send blueprints or samples today!
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KIRK & BLUM
WELDED MACHINE BASES, PEDESTALS and FRAMES
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Pressed Steel Louver Panels and Cover Plates
THE KIRK & BLUM MFG. CO.
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WIRE AND METAL SPECIALTIES
In round, flat, square and special shaped wire and ribbon stock in all metals.
LARGE PRODUCTION CAPACITY
Plating and finishing.
EASTERN TOOL & MFG. CO.
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SWAGING AND HAMMERING WORK
We're equipped with all modern facilities to handle production swaging and hammering at low cost. Can work to limits of .0005 on work from .006 to 3 in. dia.—any metals or alloys—any quantities. Prompt, accurate service guaranteed.
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FIRST-CLASS DRAFTSMAN

Wanted by established manufacturer in malleable iron and welded-steel products field.

Should have technical and thorough practical training, preferably obtained in actual shop work. Engineering graduate preferred, but man with good technical back-ground stands an equal chance.

Applicant should be a type who can step into more responsible positions when such openings develop. Permanent employment. Salaried position. Give age, schooling, and experience.

Reply will be held in strictest confidence.

P-997, American Machinist
330 W. 42nd St., New York City

POSITIONS VACANT

PLANT SAFETY AND PERSONNEL WORK. Engineering graduate with several years experience or equivalent. Good background and executive ability essential. Location western New York. P-998, American Machinist, 330 W. 42nd St., New York, N. Y.

YOUNG GRADUATE ENGINEER with at least three years experience in oil or motor company engine laboratory, preferably on lubricating oil problems, for engine work in laboratory employed in lubricating oil research. Give full details, personal data, education, experience, salary, recent photograph, etc., in first reply. Location, eastern seaboard. P-14, American Machinist, 330 W. 42nd St., New York, N. Y.

TIME STUDY ENGINEER — Must have at least 5 years experience in machine shop work. Plant located in Southern Ohio. P-15, American Machinist, 520 N. Michigan Ave., Chicago, Ill.

POSITIONS WANTED

POSITION AS SUPERINTENDENT or General Foreman in machine shop, am experienced in Heavy Machinery and Shell Manufacture. Good technical and practical background but not a College graduate. Average earnings past 8 years $4500.00 per year. Now employed but would like to make change by May 1. PW-993, American Machinist, 330 W. 42nd St., New York, N. Y.

SHOP SUPERINTENDENT — Thoroughly experienced in shop methods and processes and all phases of machine and tool work. Age—46. Technical education. Prefer Chicago location. PW-999, American Machinist, 520 N. Michigan Ave., Chicago, Ill.

ENGINEERING DEPARTMENT group supervisor experienced on drafting, checking, designing, statistics, and charts desires position where this experience would be of value. PW-16, American Machinist, 520 N. Michigan Ave., Chicago, Ill.

PRODUCTION MANAGER or Shop Superintendent. Thoroughly experienced in high production of oil engines, tractors, etc. Excellent record in last war. PW-17, American Machinist, 330 W. 42nd St., New York, N. Y.

AVAILABLE . . .

Machine Tool Man

with more than twenty-five years practical and executive experience in this country and abroad.

Have been consecutively operator, shop foreman, demonstrator, service man sales representative, district manager and . . .

EUROPEAN DIRECTOR of sales for high grade American machine tool manufacturer.

Offers services where ability and experience will be applied most advantageously.

Write to

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330 W. 42nd St., New York City

FOR SALE
COMPLETE MACHINE SHOP AND FOUNDRY
Located Pittsburgh District

Equipped for heavy machinery manufacturing including planers, lathes, boring mills, radial drills, tool room, foundry and plate fabricating equipment. Approx. 60,000 sq. ft. floor space, brick & steel buildings, 3 electric overhead cranes, railroad siding, ample land for expansion.

For details, write

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PATENTS—Booklet free. Highest references. Best results. Watson E. Coleman, Patent Lawyer, 724 Ninth Street, Washington, D. C.

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Who are above average and are considering a change, we offer a personalized ethical placement service on a % fee basis. No advance charges. Your applications are invited in strict confidence.

Curt E. Patton Personnel Engineers
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OFFICES AND SHOWROOMS AT — LONDON, COVENTRY, GLASGOW, MANCHESTER, BIRMINGHAM, SHEFFIELD, BRISTOL, NEWCASTLE, CALCUTTA, BOMBAY, SYDNEY, MELBOURNE, OSAKA, TOKIO, BUENOS AIRES.

representing a number of leading United States makers of machine tools and workshop equipment can undertake additional agencies.

Resident representation in the United States

R. A. Smith c/o W. P. Neth Co.
44 Whitehall Street, New York

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Must Be Experienced in Production Tool Sales, for New England Territory. Give full details including age, experience, references and a picture in first letter.

SW-987, American Machinist
330 West 42nd St., New York City

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Business and Industrial PROPERTIES and PLANTS

Building Suitable For Sub-Contract Manufacturing or Sub-Assembly

STEEL and BRICK BUILDING—Modern, one-story, containing approximately 28,000 sq. ft. of floor space. Building is well lighted and equipped with two 3-ton and two 5-ton floor-operated cranes. Separate service building equipped with washroom and toilet facilities, and an office building with an area of 2,400 sq. ft. Parking space nearby. Shipping facilities include spur track into main building arranged for car-floor-level loading. All contained on about 1¾ acres, approximately 75,000 square feet of land, Houston, Texas.

8 ACRES OF LAND with frontage on a main highway and Christiana River and with riparian rights on the river. Suitable for oil tank farm, or manufacturing purposes. Centrally located. Wilmington, Del.

50 ACRES OF LAND with 1100 feet frontage on the Indiana Harbor Canal, and 2000 ft. frontage on Dickey Road. Rail and water transportation facilities. East Chicago, Indiana.

MILL BUILDING, containing 22,500 sq. ft. of floor space, on a tract of about 8 acres of land. Railway facilities adjoining. Ample housing facilities nearby. Pa.

For detailed information or an appointment to inspect these properties, write

BO-996, American Machinist
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PROFESSIONAL SERVICES

FOR SALE AT A BARGAIN PRICE
THE GREAVES-KLUSMAN TOOL CO'S LATHE BUSINESS

All drawings, patterns, jigs, tools, fixtures, parts inventory, etc., for the complete line.

All sizes from 14" to 30" inclusive. Geared Head Single Pulley Drive and Cone Head Types: Accessories, etc.

These high grade engine lathes have been on the market over forty years.

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Machine Tool Designing Engineers

30 Years Experience in Designing, Building & Developing Production Machinery & Processing Operations

Automotive — Tractor
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1115 E. 35 St., Indianapolis, Indiana

SURPLUS TOOLS FOR SALE

1—#820 Bliss Strip Feed Press complete with 8 sets change gears motor driven. This press was used only two months and is for sale because we have discontinued this item.

1—#2—18 Baird Four Slide with press attachment and motor drive. This machine was never used.

SHEET METAL SPECIALTY CO.
FOLLANSBEE, W. VA.

ReMANUFACTURED MACHINE TOOLS
-(ORIGINATED BY US)-

Reg. U. S. Patent Office

HILL-CLARKE MACHINERY CO.

See list below of our

MOTOR DRIVEN NORTON GRINDERS

Guaranteed new machine performance . . . at low cost . . .

Established 1867

HILL-CLARKE MACHINERY CO. CHICAGO U.S.A.

PRECISION

True alignment of — spindle — wheel slide — and table together with accurate fitting of component parts—insures precision limits of accuracy.

FINISH

Elimination of all gears in work head — results in extremely fine finish.

VIBRATION

Rigid mounting of specially balanced motors—dynamically and statically balanced sheaves—have reduced vibration to a minimum—essential to precision and fine finish.

HOW EXTREME ACCURACY and FINISH ARE OBTAINED:

★ The seasoned bed casting, wheel slide, and table bearing surfaces are planed, indicated, scraped, and lapped enabling a perfect alignment.

The spindle is ground and carefully fitted to its bearing boxes—and then with a wheel mounted on it, run continuously for several days.

Vibration is minimized because specially balanced constant speed motors are used in conjunction with statically balanced sheaves and matched V-belts. These sheaves are also balanced dynamically to suit the individual machine.

The PATENTED MULTIPLE V-BELT DRIVE to work spindle—and a constant speed motor—provide the smooth, continuous rotation necessary for fine finish and precision grinding.

COVERED BY U. S. PATENT NUMBERS

2074308	2112126
2095089	2139397

SIZES IN STOCK:

6″ x 32″	10″-15″ gap x 72″
10″ x 18″	14″ x 36″
10″-15″ gap x 18″	14″ x 50″
10″ x 24″	14″ x 72″
10″-15″ gap x 24″	16″ x 50″
10″ x 36″	16″ x 72″
10″ x 50″	16″ x 120″
10″ x 72″	18″ x 96″

18″-24″ gap x 96″

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Office—651 W. Washington Blvd. **CHICAGO, ILL.**

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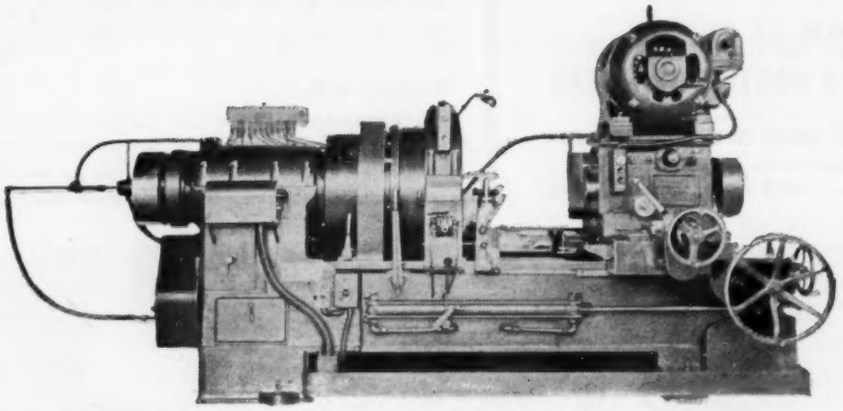
For Shells, Forgings & Other Defense Products
5 Available for Immediate Delivery



Arranged for 3 Motor Drive with Taper Attachment
Without Hand Tool Slide & Hydraulic Power Traverse

New Cost: Approx. $9,000.00 ***Our Price $4,750.00***

LOUIS E. EMERMAN & CO. 1761 ELSTON AVE. CHICAGO, ILLINOIS

MODERN MACHINES—IMMEDIATE DELIVERY!
COMPLETE PLANT

We have just secured a complete plant, and offer for immediate delivery the machinery listed below. All items may be inspected on their original foundations, and we suggest your prompt inspection of the machines of interest to you.

1—**RACINE TOOL & MACHINE CO.**, 6"x 6" **Power Hack Saw**
1—**Bench type** double end **emery grinder** ¾"x19"
1—**Special tumbler polishing machine** 13½"x14"
1—**BROWN & SHARPE** #2 **Tool Grinder,** with all fixtures
1—**DARAG Scallop milling machine** 5⅝"x 17⅝" table
1—**HERMAN Ulbright** Vertical cam **milling machine,** 20" table
1—**AURORA TOOL WORKS** 24" vertical back geared **sliding head drill**
1—**BUFFALO FORGE CO.** Junior 10" vertical bench type **sensitive drill**
1—**NILES-BEMENT-POND** 36"x36"x22' **standard planer**
1—**QUEEN CITY MACHINE TOOL CO.,** back geared **crank shaper**
1—**AMERICAN TOOL WORKS CO.** 24"x 10' geared head quick change **engine lathe**
1—**WHITCOMB BLAISDELL MACHINE TOOL CO.,** 16"x10' double back geared **engine lathe**
1—Special bench **filling machine**
1—**W. C. YOUNG MFG CO.,** 12"x6' single back geared standard **engine lathe**
1—**HERMAN ULBRIGHT combination slot milling and drilling machine,** 12"x 40" table
1—**SENECA FALLS MFG. CO.,** 9"x4' single back geared standard **engine lathe**
1—**NEW HAVEN MFG. CO.,** 20"x10' double back geared quick change **engine lathe**
1—**GREAVES-KLUSMAN & CO.** 18"x6' single back geared quick change **engine lathe**
1—**LODGE & SHIPLEY MACHINE TOOL CO.,** 20"x8' double back geared quick change **engine lathe**
1—**WOOD TURRET MACHINE CO.** plain head tilted **turret lathe,** 64" bed, 7" diam. turret
1—18" **PRENTICE engine lathe (rebuilt) geared head,** motor drive
1—3" bar capacity **JONES & LAMSON turret lathe** (rebuilt) single pulley drive
1—#4 **WARNER & SWASEY screw machine** (rebuilt) bar capacity 1½" cone drive with back gear and clutch
1—#2 **WARNER & SWASEY screw machine** (rebuilt) bar capacity 1", cone drive with back gear and clutch
1—#4 **WARNER & SWASEY screw machine** (rebuilt) bar capacity 1½" cone drive
1—#0 **BROWN & SHARPE automatic screw machine**
2—2¼"x24" **JONES & LAMSON flat turret lathe**
1—2"x100" **GISHOLT turret lathe**
5—**Other turret lathes** 1" bar capacity

DRILL PRESSES

1—WM. PELTON MACHINE CO., 14" 2 spindle vertical sensitive gang drill 12"x20" table—belt drive
1—CHAMPION BLOWER & FORGE CO. 22" vertical back geared stationary head drill 16" diam. table; tight and loose pulley drive
1—CANEDY-OTTO MFG. CO., 16" plain vertical drill, 13" diam. table; tight and loose pulley drive

MILLING MACHINES

1—KEMPSMITH MFG. CO. #3 Universal miller 12"x48" table—all power feeds overhead double friction countershaft
1—#3 CINCINNATI PLAIN Milling machine, motor drive

POWER PRESSES

1—E. W. BLISS CO., #0 styles closed back power press; adj. stroke ½"x1" throat —18"x2½" fly wheel
1—E. W. BLISS CO., #4 styles closed back power press; adj. stroke 9" throat— 42"x6¼" fly wheel

SHAPERS

1—STOCKBRIDGE MACHINE CO. 16" back geared crank shaper—tight and loose overhead countershaft—4 step cone pulley
1—**QUEEN CITY MACHINE TOOL CO.** 24" back geared crankshaper

MISCELLANEOUS MACHINES

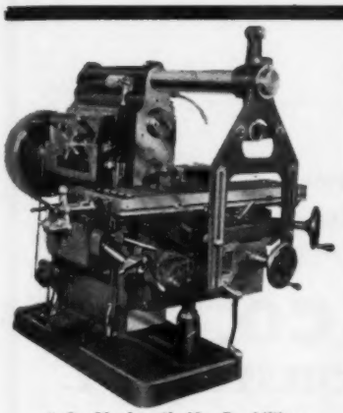
1—FAFNIR BEARING CO., #3 floor type double end grinder 2" semi-pull countershaft
CARBO MACHINE WORKS, Inc. 22"x3" belt driven wet grindstone
CHALLENGE MACHINE CO., 14" double end floor type emery grinder
CHICAGO FLEXIBLE SHAFT CO., Stewart standard furnace #805 M F D gas type combination tool hardening furnace 1 with 5½" opening; 1 with 9¾" opening; 1 load pot
1—ARMSTRONG BLUM MFG. CO. Mervel #1 Poser Shop hack saw
1—AMERICAN TOOL MFG. CO. 21" Vertical back geared stationary head drill
1—GREAT AMERICAN bench type double end emery grinder; 1"x21" spindle; 12" between wheels.

OUR REBUILT MACHINES ARE UNCONDITIONALLY GUARANTEED

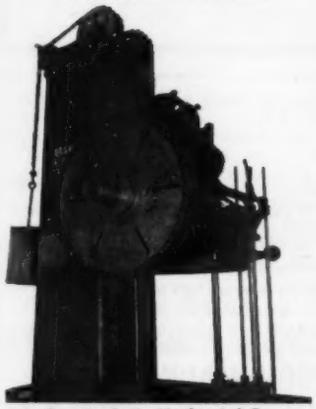
DUBERA CORPORATION

11 BROADWAY, NEW YORK CITY **Tel: WHitehall 3-7518—Cable: Duberaite, New York**

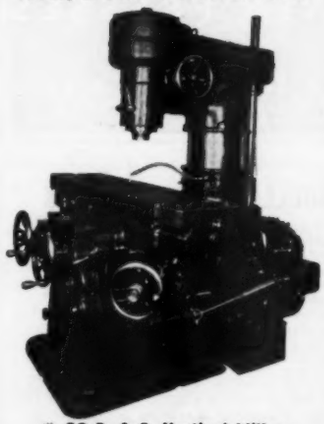
Modernize Your Machines with the New "ATLANTIC" REBUILDING METHOD



3 Cincinnati H. P. Miller
REBUILT FOR WOOLWICH ARSENAL, ENGLAND



8" Bar B. & S. Horizontal Borer
REBUILT FOR BRAZILIAN TRACTION, LIGHT & POWER CO.



5C B. & S. Vertical Miller
REBUILT FOR PROMINENT NEW ENGLAND MACHINE TOOL MANUFACTURER

Here are shown the type of machines "Atlantic" is rebuilding.

These machines have been recently fitted into plant modernization programs.

SOME OF THE MACHINES IN STOCK — CAN BE REBUILT and MOTORIZED TO YOUR SPECIFICATIONS

BORING MILLS—VERTICAL

24" Bullard with Side Head
36" Bullard with Side Head
42" Niles A.C. Motor Drive
42" Colburn A.C. Motor Drive
44" Baush A.C. Motor Drive

LATHES

14"x 7' Prentice Geared Head
18"x 8' American Geared Head
20"x14' Cisco Geared Head
20"x14' Walcott Geared Head
36"x24' Bridgeford Geared Head
42"x30' Johnson Geared Head
48"x36' Fifield Triple-Geared

MILLING MACHINES

9" Spindle Ingersoll Facing
Model C & C-2 Becker H. P. Vert.
#14 & 15 Garvin Vertical
60" Garvin Duplex
28" Cinc. Semi-Automatics

PLANERS

30"x30"x12' Whitcomb M.D.
42"x42"x12' Cincinnati (2)
42"x42"x12' Pond Rev. M.D. (2)
42"x42"x16' NBP M.D.
47"x40"x12'6" Gray M.D.
60"x60"x12' Pond Rev. M.D.
72" Morton Portable M.D.

"Much machinery, though it has seen considerable service, can be rebuilt or retooled for a defense job with a minimum of delay."

AMERICAN MACHINIST,
Dec. 11, 1940

TO THE PRODUCTION EXECUTIVE
WHO CAN'T WAIT
FOR NEW MACHINE DELIVERIES:

There is a solution to your problem! We call it Progressive Production-Line Re-Building.

Modernize your existing machines the New Atlantic Way. Rebuild them to meet your increased production demands. Recondition them to the right degree of accuracy demanded by the tasks ahead. . . .

The time involved in Progressive Re-Building is considerably shorter than generally realized. Arrangements can be made for rebuilding one or two machines at a time. You will get them back, with a minimum of delay . . . UNCONDITIONALLY GUARANTEED!

Our Machine Tool Re-Building methods are sound. We pride ourselves of our ability to do a thorough re-building job. Each Machine is tested under power before returning to the owner and we invite you to visit our Machine Tool Works to have you see the work we are doing for others and let us do the same work for you.

In addition we also carry Machine Tools in stock which we offer completely and thoroughly re-built, refinished and fully guaranteed as to their performance and accuracy.

If we can be of help, write us regarding your problems.

ATLANTIC MACHINERY CORPORATION

149 BROADWAY — **Cable Address: ATMACOR** — **NEW YORK**

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YOUR REQUIREMENTS FOR

USED & REBUILT

MACHINE TOOLS

Lathes, Milling Machines, Planers, Shapers, Grinders, Radial Drills, Drill Presses, Punch Presses, Slotters, Gear Cutters

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What Tools Have You For Sale?

Varied Stock
HIGH GRADE
MACHINE TOOLS
USED and REBUILT

- BORING MILLS—Horiz. & Vert.
- PLANERS
- LATHES
- TURRET LATHES
- GRINDERS—Univ., Plain. Internal, Rotary
- GEAR HOBBERS
- GEAR CUTTERS
- MILLING MACHINES
- RADIAL DRILLS

And all other types of machine tools

SEND YOUR INQUIRY TO:—

MOREY MACHINERY CO., Inc.
410 BROOME ST., NEW YORK

ANODIC PLATING
Generators

3—1500 ampere
1—1000 ampere
5— 800 ampere
3— 500 ampere

Self or separate excitation
10 to 40 & 10 to 60 volts D.C.
Variable voltage or flat compound at any voltage
Synchronous, Squirrel Cage or Direct Current Motor Driven
PROMPT SHIPMENT from STOCK
All rebuilt with 1 YEAR Guarantee

L. J. LAND & COMPANY
Est. 1910
153 Grand Street, New York, N. Y.
CAnal 6-3923

4 & 6 Spindle Avery Sensitive Drills, No. 2 M.T., B.B.
No. 1B, No. 2B Edlund, 2 Spindle Sensitive Drills
Landis Plain Grinders 12"x42", 12"x52", self contained countershaft, motor drive
Landis Crankshaft Grinders 16"x48", self contained countershaft, motor drive
20"x10' Monarch Lathe, Q.C.G. Cone
10' Robinson Toggle Type Press Brake
42" Colburn Boring Mill Cone Drive
No. 12, 13 Natco Drills
Allis-Chalmers Rotary Compressor, 238 cu. ft. Direct M.D. as good as new

IROQUOIS MACHINERY CO.
662 Ohio St. Buffalo, N. Y.

POWER PRESSES
BLISS, TOLEDO, V & O, ETC.
REBUILT — GUARANTEED
JOSEPH HYMAN & SONS
Tioga, Livingston and Almond Streets
Philadelphia, Pa.

Screw Machine, No. 50 National Automatic Ser. #5132
Shear, Hubbard 36" gate
Punch Press, Zeh Hahnemann 50 ton Strait Side Single Geared
Punch Press Bliss, 30 ton Strait Side 1½" stroke
Threading Lathe, 16"x6', Bridgeport Automatic
Partial List—Send Us Your Inquiries
INDUSTRIAL MACHINERY CO.
369 Dublin Ave. Columbus, Ohio

TOOL VALUES

Brown & Sharpe No. 4—36" Gear Cutter
D. E. Whiton No. 1—26" Automatic Full Universal Gear Cutter
Leland and Faulconer No. 2 Wet Tool Grinder
Cincinnati No. 1½ Tool & Cutter Grinder
Cochrane Bly No. 6 Circular Cutting-Off Machine
Newton Vertical Slab Miller
Becker No. 7 Vertical Milling Machine
Cincinnati 24" Semi-Automatic Milling Machine
National Acme 3¼" Single Spindle Gridley Automatic Screw Machine
Landis 1½" Single Head Threading Machine
Lodge & Shipley 16"x6' Simplified 3-Step Cone Head Lathe without thread chasing mechanism.
Pease 42" Model 10 Blue Print Machine

The LODGE & SHIPLEY MACHINE TOOL CO.
3055 Colerain, Cincinnati, Ohio

MISCELLANEOUS MACHINES

1—½" Landis Double Bolt Cutter
2" Landis Double Bolt Cutter
3" Landis Single Bolt Cutter
Rockford Dbl. End Boring Machine
Rockford Sgl. End Boring Machine
4' Hammond Sensi. Radial, with tapp.
#13 Natco Drill with tapping att.
#14 Natco Drill with tapping att.
#30 Natco Drill with tapping att.
#40 Natco Strt. Line Mult. Drill.
48" Newton Cont. Dbl. Spdl. Miller
#400 Curtis 2-bushel Oil Extractor
#304-A Oster Pipe Machine
½" Aetna Swaging Machine.

THE STRONG, CARLISLE & HAMMOND CO.
1392 West 3d St., Cleveland, Ohio
2832 E. Grand Blvd., Detroit, Mich.

Oliver Drill Grinder, M. D.
No. 6 Whitney Hand Mill, M. D.
25-Ton H & W Dieing Machine
Cadillac Centering Machine, M. D.
No. 1 Cinn. Tool & Cutter Grinder
D. E. DONY MACHINERY CO.
47 LAURELTON ROAD
ROCHESTER, N. Y.

#2A Warner & Swasey Turret Lathes, S.P.D.
3' Morris Radial Drill, S.P.D.
4' Ryerson Radial Drill, S.P.D.
#3—¾ Bliss Toggle Press.
27"x16' Lodge & Shipley M.D. Lathe.
42" Niles Boring Mill, S.P.D.
#2 Kempsmith Plain Miller.
#2½ LeBlond Plain Miller.
#3 Kempsmith Univ. Miller, fully equip.
VICTOR MACHINERY COMPANY
135 S. Clinton Street Chicago, Illinois

REBUILT—EQUAL TO NEW
Milwaukee #2½B Vertical Mill, S. P. D.
Warner & Swasey #2A Bar, M. D.
6" x 18" Landis Grinder, M. D.
AARON MACHINERY CO.
176 Lafayette St. New York, N. Y.

NECESSARY TOOLS

3⅝" No. 5A Defiance horizontal boring mill.
18" Gisholt Simplimatic.
2⅝ Gridley 4 spindle Model F automatic.
3½' Morris radial drill.
5' American motor-on-arm universal radial drill.
6' Niles Bement Pond universal radial drill.
Type B Billings & Spencer die sinker.
18H G&E gear hobber.
Nos. 2 & 4 Mitts & Merrill keyseaters.
21"x18' LeBlond lathe.
24"x10' Lodge & Shipley geared head lathe.
26"x15' American geared head lathe.
36"x22' Schumacher & Boye lathe.
Nos. 4, 5 & 9 Foster turret lathes.
8"x36" Jones & Lamson turret lathe.
24" Steinle turret lathe.
No. 13B Brown & Sharpe mfg. miller.
No. 1 Kempsmith plain miller
2½" Cleveland horizontal boring mill.
No. 2 & 4 LeBlond hy. dy. universal millers.
No. 2 Kempsmith universal miller.
No. 4 Cincinnati universal miller.
AB Becker vertical miller.
Model C Becker rotary table miller.
52" Gisholt vertical boring mill.
60" Colburn vertical boring mill.
61" Bullard vertical boring mill.
30"x30"x10 Cincinnati planer.
56"x56"x16 Gray planer.
No. 2 Standard screw press.
600 ton No. 664 B Toledo coining press.
24"x24"x24" Cincinnati crank shaper-planer.
36" x 48" Morton draw cut shapers.

MILES MACHINERY CO.
SAGINAW, MICH.

UNUSUAL VALUES

Brakes: Chicago 10' for 18 ga.
Shapers: 24" G&E, 24" Barker
28"x16' **Rahn-Larmon Lathe**
20"x10' **Bradford Lathe**
16"x8' **Monarch Lathe** with taper attachment.
Milling Machines: Type "B" Briggs Hor.
Drill Presses: 28", 24" Hoefer; 25", 20", 40" Bement-Niles
Hack Saw: 6 x 6 L.W. high speed
Radial Drills: 5' Bausch
Turret Lathes: ⅝" Acme, 24" Gisholt, m.d.
Miller: 20" x 24" x 18" Ingersoll
Grinders: #20 Bryant Internal; 6 x 15" Fitchburg, plain cylindrical
300 other machinery items
MOTORS—new 5 H.P. for 3-phase, ball brg. $55.75

Other sizes equally low priced. Also rebuilt motors.

THE OSBORNE & SEXTON MACHINERY CO.
COLUMBUS, OHIO

GOOD USED FABRICATING MACHINES

Prompt delivery.

10'x¾" Initial Type **Bending Rolls**, belt drive
#2 Hilles & Jones **Horizontal Punch**
#5 Hilles & Jones **S.E. Punch**
Kling Bros. **Rotary Splitting Shear**
Lennox **Bevel Shear**
Quickwork Type 3 **Shear**, 3/16" cap.
12 ft. **Hydraulic Stake Riveter**
Wood **Hydraulic Flanging Machines**
Four column **Hydraulic Press**
Four column **Hydraulic Press**, 84" area.
McCabe **Cold Flanging Machine**, ½" cap.

Also many other items of various sizes and types.

CINCINNATI MACHINERY & SUPPLY COMPANY
217 E. Second St.
Cincinnati, Ohio.

OTT MACHINERY SPECIALS

4—3" 4 spdle Nat'l Acme Mod B Automatics, S.P.D.
1¼" Gridley Model F—4 spdle, S.P.D.
#1A Edlund 4 spdle H.S.B.B. Drill, P.F. #3 M.t.
#55 & 65 Heald Cylinder Grinders.
16"x36" Norton Crank Shaft Grinders
#661 & 663 Toledo Coining Presses, Geared, 2½" str.
44"x44"x18' Niles Planer, 4 Heads.

OTT MACHINERY SALES, INC.
542 Second Ave. Detroit, Mich.

EASTERN OFFERS

ENGINE LATHES

60"x30'6" Niles Geared Head (2)
60"x27'6" Niles Geared Head
36"x22' LeBlond Geared Head
36"x10' Schumacher-Boye, cone
27"x18' LeBlond Geared Head, taper
27"x16' Bridgeford, cone
26"x18' Schumacher-Boye, cone
26"x16' Bradford Geared Head, taper
25"x18' LeBlond Geared Head, taper
24"x18' Lodge & Shipley Patent Head, taper
24"x16' Schumacher-Boye, cone
24—48"x16' McCabe 2 in 1, cone
24"x16' Axelson Geared Head, taper
24"x12' American, cone
24"x11' Chard, cone
24"x10' LeBlond, cone
24"x10' Bridgeford, cone
21"x16' LeBlond, cone
21"x10' LeBlond, cone
21"x8' LeBlond, cone, taper
20"x14' Hendey Geared Head, taper
20"x10' Lodge & Shipley, cone
20"x8' Greaves-Klusman Geared Head, taper
19"x12' LeBlond, taper, cone
19"x8' LeBlond, cone, taper
18"x15' Lehmann Geared Head, taper
18"x14' LeBlond, cone, taper
18"x13' American Geared Head, taper
18"x8' Springfield, cone, taper
18"x8' Mueller, cone, taper
18"x8' LeBlond, cone
18"x6' Schumacher-Boye, cone
16"x6' Springfield, cone, taper, relieving
18"x8' Cincinnati, cone
16"x8' Cincinnati, cone
15"x8' Sidney, cone

MILLING MACHINES

No. 5G LeBlond Universal, s.p.d.
No. 35 Oesterlein, cone
No. 3 Cincinnati Plain, cone
No. 3H LeBlond Plain, cone
No. 15 Garvin Plain, cone
No. 25 Becker Plain, cone
No. 22 Garvin Vertical, belt
Gooley & Edlund Briggs Type
No. 7H Becker Lincoln Type
Putnam Briggs Type
24" Cincinnati Plain Automatic
30"x28"x8' Ingersoll Planer Type
48" Oesterlein Tilted Offset, m.d., Timken, latest
C66A Newton 3 spindle Continuous, s.p.d.

ROLLS

10' No. 5 Niles, belt, cap. 9/16" plate, drop end
24' Niles, pyramid, strong back, shipyard type, cap. 1" plate

SHAPERS

16" Cincinnati, cone
16" Davis, gear box
20" Hendey, belt
20" Steptoe, cone
24" Barker, cone
24" Cincinnati, cone
24" Gould & Eberhardt, cone
24" Ohio, cone
24" Rockford, cone
28" Gould & Eberhardt, cone

TURRET LATHES AND SCREW MACHINES

No. 2, 3 Cincinnati Acme Universal, m.d.
No. 2A Warner & Swasey Universal, m.d.
No. 4A Warner & Swasey Universal, m.d., Timken Bearings
1" Biggs, cone
No. 4 Woods, cone
2x24" Jones & Lamson Geared Head, m.d., bar
2x26" Pratt & Whitney, cone
2 spindle Jones & Lamson Steel Head, m.d.
3x36" Jones & Lamson Geared Head, s.p.d.
2 spindle 3x36" Jones & Lamson Turret, m.d.
18" Libby Type A, m.d.
16", 20" Acme Hexagon Turret, cone
20" Acme Flat Turret, cone
21", 24" Gisholt Turret

PRESSES

No. 496D Toledo Double Crank Toggle Drawing, m.d., 95" between uprights, weight 160,000 lbs.
No. 268¼B Toledo D.C. Toggle Drawing, m.d., 84" between uprights, weight 175,000 lbs.
No. 94 Bliss Consolidated
No. 93A Toledo S.S. D.C., weight 17,000 lbs.
No. 92B Toledo D.C. geared, weight 11,200 lbs.
No. 54A Toledo Special, m.d.
DG 53 Ferracute Redrawing, m.d.
851 Ferracute D.C.
No. 50-4-36 Minster S.S. D.C.
No. 6 Waterbury Farrel D.C.
P2 Ferracute Stiles Type
DD2, D2 Ferracute D.A. Drawing
C2 Ferracute O.B.I.
No. 28 Consolidated O.B.I.
Waterbury-Farrel S.A. O.B.

Partial Listing only. Send us your inquiries.

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MACHINERY CO.
1004 TENNESSEE AVE.
CINCINNATI, OHIO

ENGINEERED *Machine Tool* REBUILDING

"The World Is Our Field"

A SOLUTION

In many a teeming defense-producing plant valuable machine tools are limping along or lying idle, obsolescent and in disrepair.

Their owners, believing them inadequate, are frantically searching for replacements. Such replacements often cannot be delivered for from 4 to 18 months.

Meanwhile the solutions stand under their very noses.

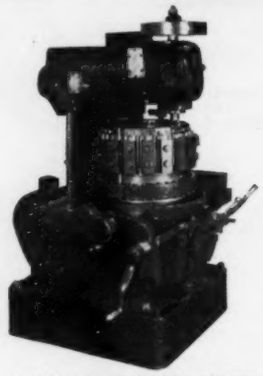
These idle machine tools can be REBUILT and RE-DESIGNED at the SIMMONS plant. Old countershaft-driven machines can be motorized. The capacity of tools such as lathes, boring mills, planers and planer-type millers can be increased. Aside from modernization, each tool rebuilt at the "Mechanical Mayo Clinic" undergoes time-tested reconditioning. It is completely dismantled, necessary parts replaced, surfaces reground.

SIMMONS, with its expanded facilities, is in a position to undertake additional rebuilding work on a *good delivery schedule.* ENGINEERED REBUILDING will add years to the productivity of semi-discarded equipment.

Look around your plants and decide which of your tools need revitalizing. Then write or telephone us and we will advise you how promptly they can be sent back "good as new."

SIMMONS
MACHINE TOOL CORP.
1759 N. BROADWAY, ALBANY, N. Y.
NEW YORK OFFICE: 149 B'WAY

UNUSUAL BARGAINS



No. 3 Sundstrand Vertical Rotary "Rigidmill". Motor Driven. Pr. Rp'd. Traverse.

54" x 19' American Roll Lathes. Internal Geared Face Plate. Swing over Bed 54"; Between Centers 11'. Arranged for M.D., Less Motors. (2).

No. 3 Thomas & Carlin Alligator Shear. Capacity 3" Billets. 32" Knife. Back Geared. Arranged for M.D., less Motor.

American Roll & Foundry Co. Alligator Shear. Capacity 2" Billets. 19½" Knife. Back Geared. Dia. of Shaft 6".

9' Canton Roll Power Square Shear. ¼" Capacity. Overhead Drive. Double Crank.

3' Pittsburgh Power Square Shear. ¼" Capacity. Overhead Drive. Arranged for M.D., Less Motor.

No. D-4 Colburn 2 Sp. Heavy Duty Mfg. Drill. No. 5 Morse Taper. Motor Driven. Power Feed to Spindles.

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QUICK DELIVERY FOR YOUR IMMEDIATE NEEDS

HAMMERS, BOARD DROP
1200# Billings & Spencer
2—1000# Bliss 3—800# Bliss

GRINDERS, CYLINDRICAL
#3 Brown & Sharpe

GRINDERS, SURFACE
#16 Blanchard
Norton 15 x 15 x 96"

LATHES, FLOOR
36 x 16 Ft. Shumacher & Boye
Walcott 20 x 12 and 20 x 14
18 x 10 Lodge & Shipley

LATHES, TURRET
Warner & Swasey No. 2-A close to 200,000 serial; No. 1-A Warner & Swasey Universal; No. 2-B Foster; J & L, Geared head, flat, 3½" hole, S.P.D.; 28" & 24" Gisholt; 28" Pond; No. 4 & No. 6 W & S, cone; Warner & Swasey No. 2 and 2-A; No. 5A and 6-A Potter & Johnston; No. 4 B B & O.

MILLING MACHINES, VERTICAL S.P.D.
Becker, #5C—#4B—Model C—#6.

MILLING MACHINES, UNIVERSAL S.P.D.
#4A B & S; #2 Kempsmith; #4 Becker
#2 Cincinnati; #2 Rockford
#2B Kearney Trecker Dble. Overarm
#1½ LeBlond

MILLING MACHINES, PLAIN
#3B Kearney Trecker Dble. Overarm
#4B B & S Dble. Overarm, motor in base
#4 Cincinnati Hi Power; #5 LeBlond
#2B Kearney Trecker; #2 & #3 Cincinnati

BORING MILLS, HORIZONTAL
3" Universal; #300 Giddings & Lewis, 4½" bar

BORING MILLS, VERTICAL
Bullard Rapid Prod. Side Head, 24" & 36"
Bullard 50" & 72"; 60" Niles
42" Niles Bement Pond

PLANERS
10 x 10 x 30 Ft. Niles, 2 swivel heads and 2 side heads, 122" between housings; 36 x 36" x 14 Ft. Detrich & Harvey, with side head; 36" x 48" x 12 Ft. Detrich & Harvey Openside; 36 x 36 x 8 Ft. Niles; 20 Ft. Niles Plate Planer; 60" x 60" x 18 Ft. Pond; 26" x 8 Ft. Cleveland Openside; 26 x 6 Ft. Cincinnati; 30" x 30" x 10 Ft.; 36" x 30" x 10 Ft. American

PRESSES, DOUBLE CRANK
133" CLEARING CRANKLESS 4-POINT SUSPENSION TYPE TRIPLE ACTION PRESS — ALL STEEL FRAME CONSTRUCTION; Self-contained, motor drive, all gears enclosed, running in oil

PRESSES, GAP FRAME
Bliss #23-J & #75½
Toledo #77

PRESSES, TOGGLE & CAM
Bliss No. 5 & No. 1½;
No. 13 Bliss, 26" stroke
No. 409 Bliss 108" between housings
Toledo Nos. 164; No. 165; No. 99 Stoll; 65N Bliss, 69N Bliss; No. 268¼ Toledo, 97" between housings

No. 6010¼ Hamilton, single geared, bed 60" x 51", friction clutch, 10¼" shaft diameter, tie rod frame.
No. 6-D Bliss, 12" stroke, 36" x 60" bed, air cushion
No. 153-C Bliss, 8" stroke, 34" x 48" bed, 48" height die space, air cushion
No. 154-G Bliss, 12" stroke, 46"x84" bed, air cushion
No. 94-G Toledo, 8" stroke, 42" x 84" bed, air cushion
No. 93-C Toledo, 5" stroke, 34" x 48" bed
No. 8 Bliss, 36" x 50" bed, 8" shaft, cush.
No. 152-B Cleveland, 36" between uprights
No. 158-B Cleveland, 10" shaft, 120" between housings
No. 154-F Cleveland, tie rod, 5" stroke, 72½ between housings
No. 206-B Toledo, gap frame, 7" shaft, 48" between housings, 4" stroke

SHAPERS
Cincinnati 16", B.G.; 24" Milwaukee 16" and 24" American SPD gear box; 16" Kelly; 28" Gould & Eberhardt Hi-Duty, M.D.; 28" Rockford; G. & E. 28", 24" and 16" Invincible type;

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INTERSTATE Machinery Co., Inc.
1439 W. Pershing Road
Chicago, Illinois

MACHINE TOOLS IN STOCK

BORING MILLS
72" Bickford Vertical, 2 hds.
4" bar Beaman & Smith Horizontal

MILLERS
No. 5 Cincinnati Hi. Power, rap. trav.
2" Pratt & Whitney Double Spline
6"x30" Pratt & Whitney Thread Miller

LATHES
18"x10' Mueller
18"x12' Whitcomb Gd. Hd.
24"x12' New Haven
26"x9' Bridgeford, cone

PRESSES
No. 178 Toledo Toggle Drawing

TURRET LATHES
1¼" Pratt & Whitney Bar-Feed
10"-2 spdle Jones & Lamson Steel Hd.
No. 5A Potter & Johnson
21" Gisholt, 3⅛" Hole
26" Libby—7½" hole

MISCELLANEOUS
#1, 1-B, 2 Campbell Nibblers
36" Morton Draw Cut Shaper
1½" Acme Bolt Threader
2" Greenfield Bolt Threader
500# Bradley Hammer
No. 4—48" B. & S. Gear Cutter
9"x9" Peerless Shaping Saw
No. 4 Hilles & Jones Double Punch & Shear
8" Standard Pipe Machine

WIGGLESWORTH MACHINERY COMPANY
203 Bent St. Cambridge, Mass.

JUST PURCHASED

8—Brown & Sharpe Automatic Screw Machines, #00, OOG, OG Ser. No. 5000 to 8000
8—Warner & Swasey #4, 6. Turret Lathes
6—Cincinnati No. 2, 3, Plain Millers
30—V & O, Bliss, O. B. I. Power Presses
8—Allen Multiple Spindle Drills
6—G. & E, Barber Coleman Gear Hobbers

AARON MACHINERY CO.
176 Lafayette St. New York, N. Y.

LIQUIDATING — MACHINE SHOP

*7—No. 55 and 2—No. 52—Acme Automatic Screw Machines Series #1914
1—Large Oil Separator Machine—American Tool & Machine Co.
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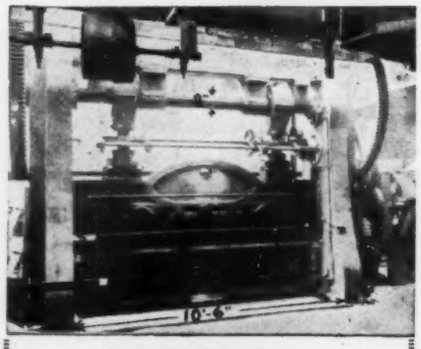

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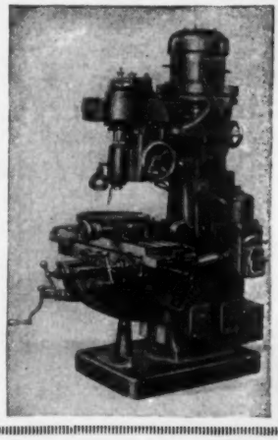

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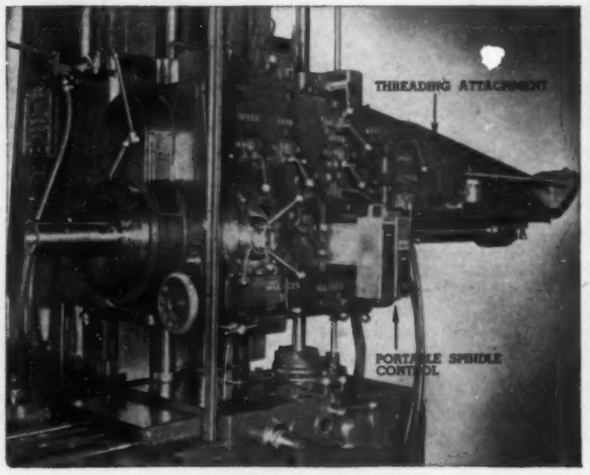

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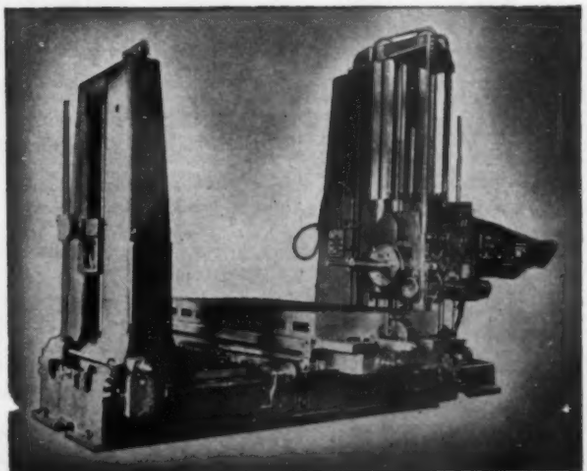

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HORIZONTAL BORING, DRILLING and MILLING MACHINES

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CHAMFERING MACHINES
Bilgram Gear & Machine Works, Philadelphia, Pa.
Sheffield Gage Co., Dayton, Ohio

CHECKS, Metal, Time and Tool
Noble & Westbrook Mfg. Co., Hartford, Conn.

CHESTS, Tool
Lufkin Rule Co., Saginaw, Mich.

CHIP SEPARATORS
De Laval Separator Co., New York, N. Y.

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Cleveland Automatic Machine Co., Cleveland, Ohio.
Gisholt Machine Co., Madison, Wis.
Goss & deLeeuw Mach. Co., New Britain, Conn.
Jones & Lamson Mach. Co., Springfield, Vt.
Kingsbury Machine Tool Corp., Keene, N. H.
National Acme Co., Cleveland, Ohio
New Britain-Gridley Machine Co., New Britain, Conn.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Snyder Tool & Engineering Co., Detroit, Mich.

CHUCKS, Automatic and Quick Changing
Errington Mech. Laboratories, Staten Island, N. Y.
Modern Tool Works, Div. of Consolidated Mach. Tool Corp. of America, Rochester, N. Y.

CHUCKS, Collet
Sundstrand Machine Tool Co., Rockford, Ill.

CHUCKS, Drill and Tap
Errington Mech. Laboratories, Staten Island, N. Y.
Jacobs Mfg. Co., Hartford, Conn.

CHUCKS, Full Floating
Errington Mech. Laboratories, Staten Island, N. Y.

CHUCKS, Gear
Le Maire Tool & Mfg. Co., Dearborn, Mich.

CHUCKS, Grinding
Sheffield Gage Co., Dayton, Ohio

CHUCKS, Lathe
Gisholt Machine Co., Madison, Wis.
Jones & Lamson Mach. Co., Springfield, Vt.

CHUCKS, Magnetic
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Machine Co., Worcester, Mass.
L. W. Chuck Co., Toledo, Ohio
Walker Co., O. S., Worcester, Mass.

CHUCKS, Spring
Brown & Sharpe Mfg. Co., Providence, R. I.

CLAMPS, Machinist
Armstrong Bros. Tool Co., Chicago, Ill.
Lufkin Rule Co., Saginaw, Mich.
Williams & Co., J. H., Buffalo, N. Y.

CLAMPS, Strap
Williams & Co., J. H., Buffalo, N. Y.

CLEANERS, Metal
Bullard Co., Bridgeport, Conn.

CLEANING SYSTEMS, Vacuum
Spencer Turbine Co., Hartford, Conn.

CLUTCHES
Fairbanks Morse & Co., Chicago, Ill.

CLUTCHES, Friction
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hill-Acme Co., Cleveland, Ohio
Johnson Mach. Co., Carlyle, Manchester, Conn.

COLLETS
Brown & Sharpe Mfg. Co., Providence, R. I.
Jones & Lamson Machine Co., Springfield, Vt.
Union Twist Drill Co., Athol, Mass.

COLLETS, Lathe
Gisholt Machine Co., Madison, Wis.
Rivett Lathe & Grinder, Inc., Boston, Mass.

COMPOUNDS, Cleaning
Oakite Products, Inc., New York, N. Y.

COMPOUNDS, Cutting, Drawing, Drilling & Grinding
Gulf Refining Co., Pittsburgh, Pa.
Oakite Products, Inc., New York, N. Y.
Sun Oil Co., Philadelphia, Pa.
Tide Water Associated Oil Co., New York, N. Y.

COMPOUNDS, Grinding & Lapping
Clover Mfg. Co., Norwalk, Conn.

COMPOUNDS, Insulation
General Electric Co., Schenectady, N. Y.

COMPOUNDS, Plastic Molding
Bakelite Corp., New York, N. Y.

COMPOUNDS, Tempering & Case Hardening
Houghton & Co., E. F., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.

COMPRESSORS, Air and Gas
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Fairbanks Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.

COMPRESSORS, Motor Starting
Fairbanks Morse & Co., Chicago, Ill.

CONTOUR MACHINES
Continental Machines, Inc., Minneapolis, Minn.

CONTRACT WORK
Ajax Iron Wks, Corry, Pa.
Alofs Mfg. Co., Grand Rapids, Mich.
American Shearer Mfg. Co., Nashua, N. H.
Baldwin Southwark Div. Baldwin Locomotive Works, Philadelphia, Pa.
Belding & Mull, Philipsburg, Pa.
Brown & Brown, Inc., Lima, Ohio
Continental Diamond Fibre Co., Newark, Del.
Coulter Machine Co., James, Bridgeport, Conn.
Denison Engineering Co., Columbus, Ohio
Dinsmore & Jager, N. Hampton, Mass.
Doyle Machine Tool Corp., Syracuse, N. Y.
Eastern Tool & Mfg. Co., Bloomfield, N. J.
Excello Corp., Detroit, Mich.
Fidelity Machine Co., Phila., Pa.
Fresh'nd Aire Co., Chicago, Ill.
General Pattern Wks., Cincinnati, O.
Greensboro Loom Reed Co., Greensboro, N. C.
Greist Mfg. Co., New Haven, Conn.
H & H Tool & Mfg. Co., Cincinnati, O.
Hamilton Tool Co., Hamilton, Ohio
Hartford Special Mchy. Co., Hartford, Conn.
Hensle Machine & Tool Wks., Emil, Carlstadt, N. J.
Hyndman Co., Inc., A. H., Chicago, Ill.
Ingersoll Milling Machine Co., Rockford, Ill.
Jacobsen Mfg. Co., Racine, Wis.
Jefferson Machine Tool Co., Cincinnati, Ohio
Johnson Mach. Co., Carlyle, Manchester, Conn.
Kirk & Blum Mfg. Co., Cincinnati, Ohio
Lincoln Mach. Co., Pawtucket, R. I.
M & M Mfg. Corp., Fortville, Ind.
Marburg Brothers, Inc., New York, N. Y.
Meisel Press Mfg. Co., Boston, Mass.
Metal Electric Processing Co., Toledo, Ohio
National Acme Co., Cleveland, Ohio
National Machine & Tool Co., Jackson, Mich.
Nilson Machine Co., A. H., Bridgeport, Conn.
Phonograph Needle Mfg. Co., Providence, R. I.
Reed Co., Charles E., Chicago, Ill.
St. John X-ray Service, Inc., Long Island City, N. Y.
Standard Pattern Co., Ft. Wayne, Ind.
Technical Development Co., New York, N. Y.
Thomas & Skinner Steel Prod. Co., Indianapolis, Ind.
Waltham Watch Co., Waltham, Mass.
Williams Iron Works, New York, N. Y.

CONTROL SYSTEMS, Production
McCaskey Register Co., Alliance, Ohio.

CONTROLLERS & STARTERS, Electric
Fairbanks Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

CONTROLLERS, Electric
Fellows Gear Shaper Co., Springfield, Vt.
Union Twist Drill Co., Athol, Mass.

CONVERTERS
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

CONVERTERS, Synchronous
General Electric Co., Schenectady, N. Y.

CONVEYOR SYSTEMS
Mathews Conveyor Co., Ellwood City, Pa.

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Veeder-Root, Inc., Hartford, Conn.

COUNTERBORES
Carboloy Co. Detroit, Mich.
Cleveland Twist Drill Co., Cleveland, Ohio
Excello Corp., Detroit, Mich.
National Twist Drill & Tool Co., Detroit, Mich.
Scully-Jones & Co., Chicago, Ill.
Slocomb Co., J. T., Providence, R. I.

COUNTERSHAFTS
Cleveland Twist Drill Co., Cleveland, Ohio
Hill-Acme Co., Cleveland, Ohio
Rivett Lathe & Grinder, Inc., Boston, Mass.

COUNTERSINKS
American Swiss File & Tool Co., Elizabeth, N. J.
National Twist Drill & Tool Co., Detroit, Mich.
Scully-Jones & Co., Chicago, Ill.

COUPLINGS, Flexible
Cullman Wheel Co., Chicago, Ill.
Farrel-Birmingham Co., Inc., Buffalo, N. Y.
Hill-Acme Co., Cleveland, Ohio
Nicholson & Co., W. H., Wilkes-Barre, Pa.

CRANES
Curtis Pneumatic Machinery Co., St. Louis, Mo.

CUTTER BLADES, Milling, Boring & Reaming
Williams & Co., J. H., Buffalo, N. Y.

CUTTERS, Boring
Carboloy Co. Detroit, Mich.

CUTTERS, Gear
Farrel-Birmingham Co., Inc., Buffalo, N. Y.
National Broach & Machine Co., Detroit, Mich.

CUTTERS, Gear (Small)
Waltham Machine Works, Waltham, Mass.

CUTTERS, Keyseater
Davis Keyseater Co., Rochester, N. Y.
National Mach. Tool Co., Cincinnati, Ohio

CUTTERS, Milling
Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Carboloy Co. Detroit, Mich.
Crafts Co., Inc., Arthur A., Boston, Mass.
Excello Corp., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Illinois Tool Works, Chicago, Ill.
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
McCrosky Tool Corp., Meadville, Pa.
Modern Tool Works, Div. of Consolidated Mach. Tool Corp. of America, Rochester, N. Y.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.

CUTTERS, Pipe, Hand
Armstrong Bros. Tool Co., Chicago, Ill.

CUTTING, Abrasive
Campbell Inc., Andrew C., Div. American Chain & Cable Co. Inc., Bridgeport, Conn.

CUTTING-OFF MACHINES
Brown & Sharpe Mfg. Co., Providence, R. I.
Etna Machine Co., Toledo, Ohio
Landis Mach. Co., Waynesboro, Pa.
Porter-McLeod Machine Tool Co., Hatfield, Mass.

CUTTING-OFF MACHINES, Abrasive
Campbell Inc., Andrew C., Div. American Chain & Cable Co. Inc., Bridgeport, Conn.
Page Steel & Wire Div. American Chain & Cable Co. Inc., Monessen, Pa.
Porter-McLeod Machine Tool Co., Hatfield, Mass.

CUTTING-OFF MACHINES, Circular Saw
Porter-McLeod Machine Tool Co., Hatfield, Mass.

CUTTING-OFF TOOLS
Williams & Co., J. H., Buffalo, N. Y.

CUTTING-OFF MACHINES, Cold Saw
Consolidated Mach. Tool Corp., Rochester, N. Y.

CUTTING, Sheet Metal
Campbell Inc., Andrew C., Div. American Chain & Cable Co. Inc., Bridgeport, Conn.

CUTTING TOOLS, Tungsten Carbide
Excello Corp., Detroit, Mich.

CYLINDERS, Hydraulic
Le Maire Tool & Mfg. Co., Dearborn, Mich.

DEALERS MACHINERY (See Searchlight Section)
Atlantic Machinery Corp., New York, N. Y.
Burr Machry Co., Chicago, Ill.
Barron Machinery Co., Chicago, Ill.
Central Mach. Tool Corp., Toledo, O.
Cincinnati Mchy. & Supply Co., Cincinnati, Ohio
Dony Machry. Co., D. E., Rochester, N. Y.
Dubera Corp., New York, N. Y.
Eastern Machinery Co., Cincinnati, Ohio
Emerman & Co., Louis E., Chicago, Ill.
Falk Machinery Co., Rochester, N. Y.
Hill Clarke Mchy. Co., Chicago, Ill.
Hyman & Sons, Jos., Philadelphia, Pa.
Indianapolis Mchy. & Supply Co., Indianapolis, Ind.
Industrial Machry. Co., Columbus, Ohio

WHERE-TO-BUY DIRECTORY

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Lake Machinery Co., Chicago, Ill.
Land & Co., L. J., New York, N. Y.
Loughran, John, Washington, D. C.
Marr Galbreath Machinery Co., Pittsburgh, Pa.
Miles Machy. Co., Saginaw, Mich.
Morey & Co., Inc., New York, N. Y.
National Machry. Exchange, New York, N. Y.
O'Brien Mchy. Co., Philadelphia, Pa.
Osborne & Sexton Machinery Co., Columbus, Ohio
Ott Mchy. Sales Co., Detroit, Mich.
Parker Machine Co., New York, N. Y.
Simmons Mach. Tool Corp., Albany, N. Y.
Strong Carlisle & Hammond Co., Cleveland, Ohio and Detroit, Mich.
Toledo Machinery Exchange Co., Toledo, Ohio
Victor Machry Co., Chicago, Ill.
Wigglesworth Machinery Co., Cambridge, Mass.

DEMAGNETIZERS
L. W. Chuck Co., Toledo, Ohio
Walker Co., O. S., Worcester, Mass.

DIAMONDS, Industrial
Crafts Co., Inc., Arthur A., Boston, Mass.

DIE CASTING MACHINES
Reed-Prentice Corp., Worcester, Mass.

DIEING MACHINES
Henry & Wright Mfg. Co., Hartford, Conn.

DIE MAKERS BLUE
Dykem Co., St. Louis, Mo.

DIE MAKERS SUPPLIES
Baumbach Mfg. Co., E. A., Chicago, Ill.
Danly Mach. Spec. Co., Inc., Chicago, Ill.

DIE MAKING MACHINES
Gorton Machine Co., George, Racine, Wis.

DIE SETS
Producto Machine Co., Bridgeport, Conn.

DIE SINKING MACHINES
Cincinnati Milling Mach. Co., The, Cincinnati, Ohio
Haskins Co., R. G., Chicago, Ill.
Oliver Inst. Co., Adrian, Mich.

DIES & TOOLS
Firth-Sterling Steel Co., McKeesport, Pa.
Hamilton Tool Co., Hamilton, Ohio

DIES, Adjustable and Self Opening
Eastern Mach. Screw Corp., New Haven, Conn.
Errington Mech. Laboratories, Staten Island, N. Y.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Mach. Co., Springfield, Vt.
Landis Mach. Co., Waynesboro, Pa.
Modern Tool Works, Div. of Consolidated Mach. Tool Corp. of America, Rochester, N. Y.
Murchey Machine & Tool Co., Detroit, Mich.

DIES, Round Adjustable
Butterfield & Co., Div. Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.

DIES, Self Opening
National Acme Co., Cleveland, Ohio

DIES, Steel Marking
Noble & Westbrook Mfg. Co., Hartford, Conn.

DIES, Sub-Press
Producto Machine Co., Bridgeport, Conn.

DIESEL FUEL INJECTION PUMPS
Excello Corp., Detroit, Mich.

DIVIDERS
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DIVIDING HEADS
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Scherr Co., George, New York, N. Y.

DOGS, Lathe and Milling Machine
Armstrong Bros. Tool Co., Chicago, Ill.
Ready Tool Co., Bridgeport, Conn.
Williams & Co., J. H., Buffalo, N. Y.

DRESSERS, Grinding Wheel
American Swiss File & Tool Co., Elizabeth, N. J.
Carboloy Co. Detroit, Mich.
Crafts Co., Inc., Arthur A., Boston, Mass.
Desmond-Stephan Mfg. Co., Urbana, Ohio
Norton Co., Worcester, Mass.
Victor Machinery Exchange, New York, N. Y.

DRILL HEADS
U. S. Drill Head Co., Cincinnati, Ohio

DRILL HEADS, Unit Type
Bradford Machine Tool Co., Cincinnati, Ohio

DRILL INDEX
Huot Mfg. Co., St. Paul, Minn.

DRILL SPEEDERS
Graham Mfg. Co., Providence, R. I.

DRILL STANDS
Black & Decker Mfg. Co., Towson, Md.

DRILL UNITS
Le Maire Tool & Mfg. Co., Dearborn, Mich.

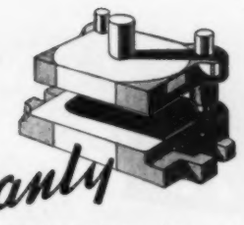
DRILLING & TAPPING HEADS, Multiple
Errington Mech. Laboratories, Staten Island, N. Y.

DRILLING & TAPPING MACHINES
Bullard Co., Bridgeport, Conn.

DRILLING MACHINES, Automatic & Semi-Automatic
Avey Drilling Machine Co., Cincinnati, Ohio
Barnes Drill Co., Rockford, Ill.
Cincinnati Bickford Tool Co., Cincinnati, Ohio
Davis & Thompson Co., Milwaukee, Wis.
Kingsbury Mach. Tool Corp., Keene, N. H.
Sundstrand Machine Tool Co., Rockford, Ill.

DRILLING MACHINES, Bench
Avey Drilling Machine Co., Cincinnati, Ohio
Barnes Co., W. F. & John, Rockford, Ill.

DRILLING MACHINES, Gang
Avey Drilling Machine Co., Cincinnati, Ohio



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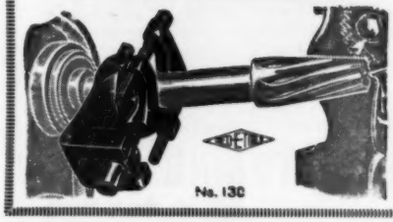

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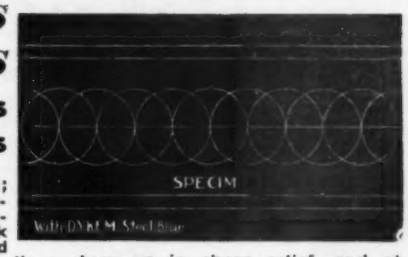

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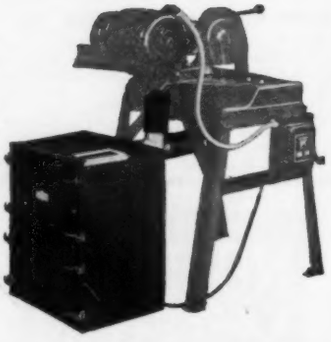

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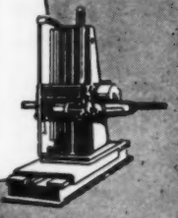

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Cleerman Machine Tool Co., Chicago, Ill.
Consolidated Mach. Tool Corp., Rochester, N. Y.
Foote-Burt Co., Cleveland, Ohio.

DRILLING MACHINES, Horizontal
Bradford Machine Tool Co., Cincinnati, Ohio
Kingsbury Mach. Tool Corp., Keene, N. H.

DRILLING MACHINES, Radial
American Tool Works Co., Cincinnati, Ohio
Bryant Machinery & Engineering Co., Chicago, Ill.
Carlton Machine Tool Co., Cincinnati, Ohio
Cincinnati Bickford Tool Co., Cincinnati, Ohio
Cincinnati-Gilbert Machine Tool Co., Cincinnati, Ohio
Cleveland Punch & Shear Works, Inc., Cleveland, Ohio
Fosdick Machine Tool Co., Cincinnati, Ohio.

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Barnes Co., W. F. & John, Rockford, Ill.
Cleerman Machine Tool Co., Chicago, Ill.
Dumore Co., Racine, Wis.
Fosdick Machine Tool Co., Cincinnati, Ohio
Henry & Wright Mfg. Co., Hartford, Conn.
Kingsbury Mach. Tool Corp., Keene, N. H.
Leland Gifford Co., Worcester, Mass.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.

DRILLING MACHINES, Turret
Kingsbury Mach. Tool Corp., Keene, N. H.

DRILLING MACHINES, Upright Multiple Spindle
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Avey Drilling Machine Co., Cincinnati, Ohio
Barnes Co., W. F. & John, Rockford, Ill.
Barnes Drill Co., Rockford, Ill.
Cincinnati Bickford Tool Co., Cincinnati, Ohio
Cleerman Machine Tool Co., Chicago, Ill.
Consolidated Mach. Tool Corp., Rochester, N. Y.
Foote-Burt Co., Cleveland, Ohio.
Fosdick Machine Tool Co., Cincinnati, Ohio
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Kingsbury Mach. Tool Corp., Keene, N. H.
Moline Tool Co., Moline, Ill.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.

DRILLING MACHINES, Vertical
Avey Drilling Machine Co., Cincinnati, Ohio
Barnes Co., W. F. & John, Rockford, Ill.
Barnes Drill Co., Rockford, Ill.
Bradford Machine Tool Co., Cincinnati, Ohio
Bryant Machinery & Engineering Co., Chicago, Ill.
Cleerman Machine Tool Co., Chicago, Ill.
Foote-Burt Co., Cleveland, Ohio
Leland Gifford Co., Worcester, Mass.

DRILLS
Cleveland Twist Drill Co., Cleveland, Ohio
Firth-Sterling Steel Co., McKeesport, Pa.
Greenfield Tap & Die Corp., Greenfield, Mass.

DRILLS, Brick, Stone, Cement, etc.
Armstrong Bros. Tool Co., Chicago, Ill.

DRILLS, Center
Cleveland Twist Drill Co., Cleveland, Ohio
Slocomb Co., J. T., Providence, R. I.
Union Twist Drill Co., Athol, Mass.
Victor Machinery Exchange, New York, N. Y.

DRILLS, Core
Excello Corp., Detroit, Mich.

DRILLS, Portable, Electric
Black & Decker Mfg. Co., Towson, Md.
Dumore Co., Racine, Wis.
Standard Electrical Tool Co., Cincinnati, Ohio

DRILLS, Pneumatic
Dumore Co., Racine, Wis.

DRILLS, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, Ohio
Union Twist Drill Co., Athol, Mass.

DRILLS, Twist and Flat
Carboloy Co. Detroit, Mich.
Cleveland Twist Drill Co., Cleveland, Ohio
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Union Twist Drill Co., Athol, Mass.

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Lima Electric Motor Co., Lima, Ohio.

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Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

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Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

ELECTRODES, Welding
Lincoln Electric Co., Cleveland, Ohio

ELEVATING TABLES, Portable
Hamilton Tool Co., Hamilton, Ohio

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Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, Ohio
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Scully-Jones & Co., Chicago, Ill.
Union Twist Drill Co., Athol, Mass.

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K MT

WHERE-TO-BUY DIRECTORY

ENGINEERING SERVICE
Ives Engineering Laboratories, Inc., Chicago, Ill.

ENGINES, Die Set
Fairbanks Morse & Co., Chicago, Ill.

ENGINES, Oil, Gas & Steam
Fairbanks Morse & Co., Chicago, Ill.

ENGRAVING MACHINES & SUPPLIES
Gorton Machine Co., George, Racine, Wis.
Preis Engraving Machine Co., H. P., Newark, N. J.

ETCHERS, Electric
Brewster-Squires Co., New York, N. Y.

EYE BOLTS
Williams & Co., J. H., Buffalo, N. Y.

FACE PLATES
Brown & Sharpe Mfg. Co., Providence, R. I.

FACING MACHINES, Precision
Excello Corp., Detroit, Mich.

FANS, Electric
Wagner Electric Corp., St. Louis, Mo.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

FANS, Ventilating
Wagner Electric Corp., St. Louis, Mo.

FENCE, Chain Link
Page Steel & Wire Div. American Chain & Cable Co. Inc., Monessen, Pa.

FILES & RASPS
American Swiss File & Tool Co., Elizabeth, N. J.
Grobet File Corp. of America, New York, N. Y.
Nicholson File Co., Providence. R. I.

FILES, Precision
Grobet File Corp. of America, New York, N. Y.

FILES, Rotary
American Swiss File & Tool Co., Elizabeth, N. J.

FILING MACHINES
Continental Machines, Inc., Minneapolis, Minn.
Haskins Co., R. G., Chicago, Ill.
Illinois Tool Works, Chicago, Ill.
Oliver Instrument Co., Adrian, Mich.

FITTINGS, Hydraulic
Vickers, Inc., Detroit, Mich.

FITTINGS, Pipe
Lamson & Sessions Co., Cleveland, Ohio

FLEXIBLE SHAFT EQUIPMENT
Haskins Co., R. G., Chicago, Ill.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.

FORGING MACHINES
National Machinery Co., Tiffin, Ohio

FORGINGS, Aluminum
Aluminum Co. of America, Pittsburgh, Pa.
Williams & Co., J. H., Buffalo, N. Y.

FORGINGS, Brass
Revere Copper & Brass Inc., New York, N. Y.

FORGINGS, Copper, Brass & Bronze
Williams & Co., J. H., Buffalo, N. Y.

FRICTION PULLEYS
Brown & Sharpe Mfg. Co., Providence, R. I.

FUEL OIL
Standard Oil Co. (Indiana), Chicago, Ill.
Texas Co., New York, N. Y.

FURNACES, Brazing
Firth-Sterling Steel Co. McKeesport, Pa.

FURNACES, Carburizing
Surface Combustion Corp., Toledo, Ohio

FURNACES, Direct Heat, Elec.
Electric Furnace Co., Salem, Ohio
General Electric Co., Schenectady, N. Y.

FURNACES, Electric
Electric Furnace Co., Salem, Ohio
Hevi Duty Electric Co., Milwaukee, Wis.

FURNACES, Forging
Hones, Inc., Chas. A., Baldwin, N. Y.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

FURNACES, Gas
Hones, Inc., Chas. A., Baldwin, N. Y.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

FURNACES, Heat-Treating, Tempering and Annealing
Hevi Duty Electric Co., Milwaukee, Wis.
Hones, Inc., Chas. A., Baldwin, N. Y.
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

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Surface Combustion Corp., Toledo, Ohio

FURNACES, Melting
Hones, Inc., Chas. A., Baldwin, N. Y.

FURNACES, Oil Fired
Electric Furnace Co., Salem, Ohio

FURNACES, Soldering
Hones, Inc., Chas. A., Baldwin, N. Y.

FURNITURE, Machine Shop
New Britain-Gridley Machine Co., New Britain, Conn.

GAGE BLOCKS
Ford Motor Co. (Johansson Div.), Dearborn, Mich.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.

GAGES, Comparator
Ames Co., B. C., Waltham, Mass.
Federal Products Corp., Providence, R. I.
Jones & Lamson Mach. Co., Springfield, Vt.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Scherr Co., George, New York, N. Y.
Sheffield Gage Co., Dayton, Ohio

GAGES, Depth
Ames Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.
Sheffield Gage Co., Dayton, Ohio
Starrett Co., L. S., Athol, Mass.

GAGES, Dial
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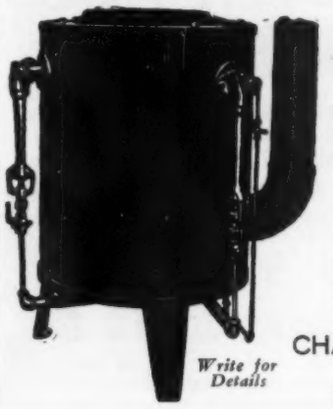

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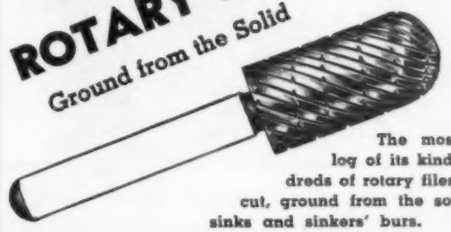

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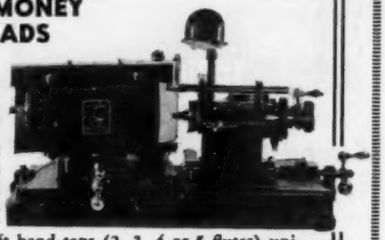

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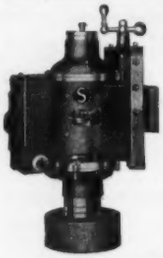

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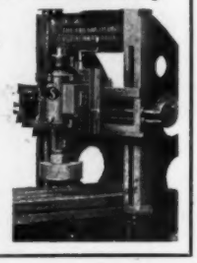

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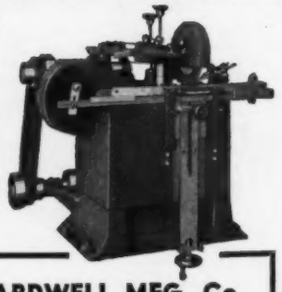

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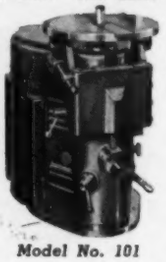

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Williams & Co., J. H., Buffalo, N. Y.

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Le Maire Tool & Mfg. Co., Dearborn, Mich.

GAGES, Plug and Ring
Brown & Sharpe Mfg. Co., Providence, R. I.
Crafts Co., Inc., Arthur A., Boston, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Machine Co., Hartford, Conn.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Sheffield Gage Co., Dayton, Ohio
Williams & Co., J. H., Buffalo, N. Y.

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Federal Products Corp., Providence, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Machine Co., Hartford, Conn.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Sheffield Gage Co., Dayton, Ohio
Slocomb Co., J. T., Providence, R. I.

GAGES, Standard
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Sheffield Gage Co., Dayton, Ohio

GAGES, Surface
Ames Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Sheffield Gage Co., Dayton, Ohio
Starrett Co., L. S., Athol, Mass.

GAGES, Taper
Brown & Sharpe Mfg. Co., Providence, R. I.
Sheffield Gage Co., Dayton, Ohio

GAGES, Thickness
Ames Co., B. C., Waltham, Mass.
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Sheffield Gage Co., Dayton, Ohio
Starrett Co., L. S., Athol, Mass.

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Gleason Works, Rochester, N. Y.
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Producto Machine Co., Bridgeport, Conn.
Scherr Co., George, New York, N. Y.

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Gleason Works, Rochester, N. Y.
Lees-Bradner Co., Cleveland, Ohio.
National Broach & Machine Co., Detroit, Mich.

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Ganschow Gear Co., Chicago, Ill.
Grant Gear Works, Boston, Mass.
Perkins Mach. & Gear Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia, Pa.

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Bilgram Gear & Machine Works, Philadelphia, Pa.
Braun Gear Corp., Brooklyn, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Gear Co., Cincinnati, Ohio.
Earle Gear & Machine Co., Phila., Pa.
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Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
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Gear Specialties Inc., Chicago, Ill.
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Hartford Special Mchy. Co., Hartford, Conn.
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Meisel Press Mfg. Co., Boston, Mass.
Perkins Mach. & Gear Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia, Pa.

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Braun Gear Corp., Brooklyn, N. Y.
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Perkins Mach. & Gear Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia, Pa.

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Sun Oil Co., Philadelphia, Pa.
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Tide Water Associated Oil Co., New York, N. Y.

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GRINDERS, Electric
Hobart Brothers, Troy, Ohio

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Norton Co., Worcester, Mass.

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Cincinnati Grinders, Incorporated, Cincinnati, Ohio

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Heald Mach. Co., Worcester, Mass.

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Cincinnati Grinders, Incorporated, Cincinnati, Ohio
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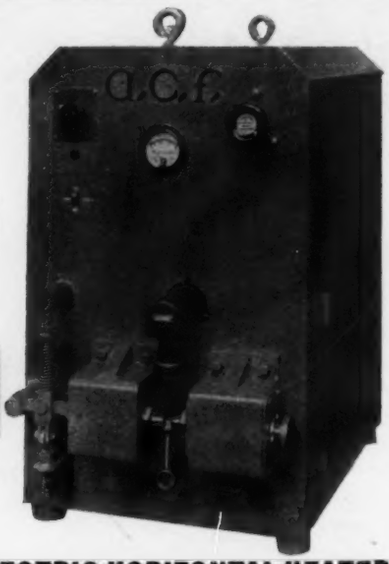

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Fitchburg Grinding Machine Corp., Fitchburg, Mass.

GRINDING MACHINES, Surface
Abrasive Machine Tool Co., East Providence, R. I.
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Norton Co., Worcester, Mass.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
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Williams & Co., J. H., Buffalo, N. Y.

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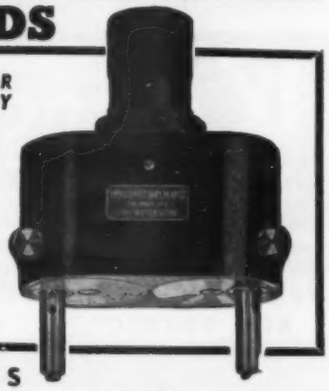

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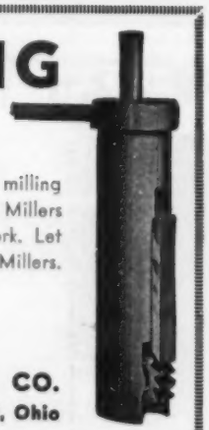

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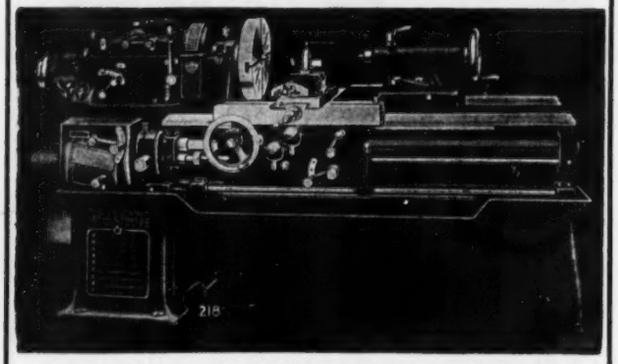

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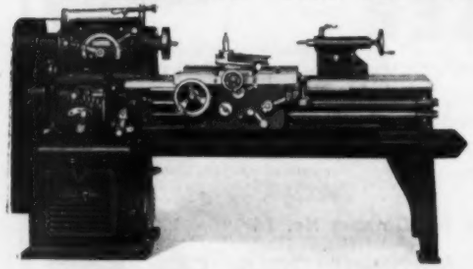

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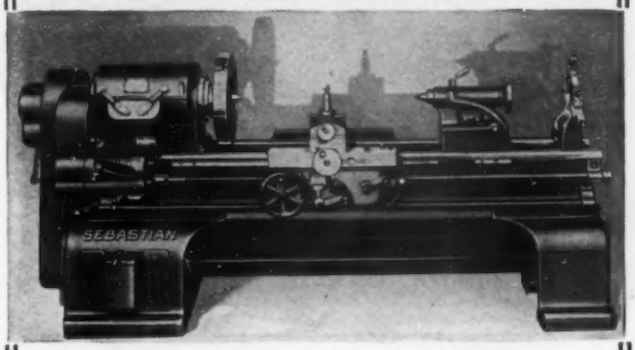

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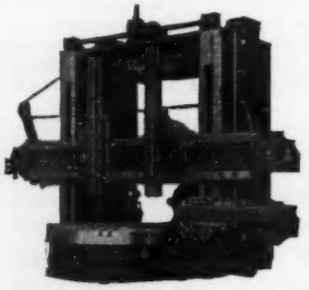

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Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

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General Electric Co., Schenectady, N. Y.

MOTORS, Integral H. P.
General Electric Co., Schenectady, N. Y.

MOULDS, Lead Hammer
Johnson Tool Co., East Providence, R. I.

NIBBLING
Campbell Inc., Andrew C., Div. American Chain & Cable Co. Inc., Bridgeport, Conn.

NUMBERING MACHINES
Noble & Westbrook Mfg. Co., Hartford, Conn.

NUT RUNNERS, Portable, Electric
Black & Decker Mfg. Co., Towson, Md.

NUTS, Lock
Elastic Stop Nut Corp., Union, N. J.
Standard Pressed Steel Co., Jenkintown, Pa.

NUTS, Self Locking
Elastic Stop Nut Corp., Union, N. J.

OIL EXTRACTORS, Centrifugal
De Laval Separator Co., New York, N. Y.

OIL GROOVING MACHINES
National Mach. Tool Co., Cincinnati, Ohio
Wicaco Machine Corp., Philadelphia, Pa.

OIL STONES
Norton Co., Worcester, Mass.

OILS, Cutting & Lubricating
Houghton & Co., E. F., Philadelphia, Pa.
Socony-Vacuum Oil Co., Inc., New York, N. Y.
Stuart Oil Co., D. A., Chicago, Ill.
Texas Co., New York, N. Y.

OILS, Quenching
Houghton & Co., E. F., Philadelphia, Pa.
Stuart Oil Co., D. A., Chicago, Ill.

PANELS, Hydraulic
Le Maire Tool & Mfg. Co., Dearborn, Mich.

PARALLELS
Brown & Sharpe Mfg. Co., Providence, R. I.
Ford Motor Co. (Johansson Div.), Dearborn, Mich.
Starrett Co., L. S., Athol, Mass.
Walker Co., O. S., Worcester, Mass.

PILLOW BLOCKS
Ahlberg Bearing Co., Chicago, Ill.
Marlin-Rockwell Corp., Jamestown, N. Y.

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Murchey Machine & Tool Co., Detroit, Mich.
Oster Mfg. Co., Cleveland, Ohio

PIPE FITTERS TOOLS
Greenfield Tap & Die Corp., Greenfield, Mass.
Williams & Co., J. H., Buffalo, N. Y.

PIPE PLUGS
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PLANERS
Cincinnati Planer Co., Cincinnati, Ohio
Cleveland Punch & Shear Works, Inc., Cleveland, Ohio
Consolidated Mach. Tool Corp., Rochester, N. Y.
General Machinery Co., Hamilton, Ohio
Liberty Planer & Mfg. Co., Hamilton, Ohio
Niles Tool Works Co., Hamilton, O.
Ohio Machine Tool Co., Kenton, Ohio.
Rockford Machine Tool Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

PLASTICS, Laminated & Molded
Continental-Diamond Fibre Co., Newark, Del.

PLATES, Aluminum
Aluminum Co. of America, Pittsburgh, Pa.

PLATES, Steel
Ingersoll Steel & Disc. Div. Borg Warner Corp., New Castle, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Ryerson & Son, Inc., Jos. T., Chicago, Ill.

POLISHING and BUFFING MACHINES
Continental Machines, Inc., Minneapolis, Minn.
Dumore Co., Racine, Wis.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Haskins Co., R. G., Chicago, Ill.
Heald Mach. Co., Worcester, Mass.
Hill-Acme Co., Cleveland, Ohio
Landis Tool Co., Waynesboro, Pa.
Mattison Machine Works, Rockford, Ill.
New Britain-Gridley Machine Co., New Britain, Conn.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Standard Electrical Tool Co., Cincinnati, Ohio
Union Twist Drill Co., Athol, Mass.

POLISHING GRAINS, Abrasive
Carborundum Co., Niagara Falls, N. Y.

POWER UNITS
Enterprise Machine Parts Corp., Detroit, Mich.

PRESS FEEDS
V & O Press Co., Hudson, N. Y.

PRESSES, Arbor
Atlas Press Co., Kalamazoo, Mich. Mich.
Barnes Co., W. F. & John, Rockford, Ill.
Famco Machine Co., Racine, Wis.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Wilson, K. R., Buffalo, N. Y.

PRESSES, Drop Forging
Niagara Machine & Tool Wks., Buffalo, N. Y.

PRESSES, Foot & Hand
Famco Machine Co., Racine, Wis.
Niagara Machine & Tool Wks., Buffalo, N. Y.

PRESSES, Forcing
Barnes Co., W. F. & John, Rockford, Ill.
Lucas Mach. Tool Co., Cleveland, Ohio
Oilgear Co., Milwaukee, Wis.

PRESSES, Hydraulic
American Broach & Machine Co., Ann Arbor, Mich.
Baldwin Southwark Div. Baldwin Locomotive Works, Philadelphia, Pa.
Denison Engineering Co., Columbus, Ohio
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Oilgear Co., Milwaukee, Wis.

PRESSES, Power
Cincinnati Shaper Co., Cincinnati, Ohio
Clearing Machine Corp., Clearing, Ill.

WHERE-TO-BUY DIRECTORY

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Henry & Wright Mfg. Co., Hartford, Conn.
Niagara Machine & Tool Wks., Buffalo, N. Y.
Oilgear Co., Milwaukee, Wis.
Quickwork-Whiting Corp., Harvey, Ill.
V & O Press Co., Hudson, N. Y.

PRESSES, Screw
Barnes Co., W. F. & John, Rockford, Ill.

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McCaskey Register Co., Alliance, Ohio.

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Morey Machinery Co., Inc., New York, N. Y.
Reed-Prentice Corp., Worcester, Mass.

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Hill-Acme Co., Cleveland, Ohio
Johnson Mach. Co., Carlyle, Manchester, Conn.

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New Jersey Machine Corp., Hoboken, N. J.

PUMPS, Centrifugal
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Brown & Sharpe Mfg. Co., Providence, R. I.

PUMPS, Hydraulic
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Oilgear Co., Milwaukee, Wis.
Vickers, Inc., Detroit, Mich.

PUMPS, Lubricant
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Fairbanks Morse & Co., Chicago, Ill.
Ruthman Machinery Co., Cincinnati, Ohio
Vickers, Inc., Detroit, Mich.

PUMPS, Oil
Brown & Sharpe Mfg. Co., Providence, R. I.
Fairbanks Morse & Co., Chicago, Ill.
Ruthman Machinery Co., Cincinnati, Ohio
Vickers, Inc., Detroit, Mich.

PUMPS, Power
Fairbanks Morse & Co., Chicago, Ill.
Oilgear Co., Milwaukee, Wis.
Vickers, Inc., Detroit, Mich.

PUNCHES, Center & Hand
Lufkin Rule Co., Saginaw, Mich.

PUNCHES, Power
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Mitts & Merrill, Saginaw, Mich.
Niagara Machine & Tool Wks., Buffalo, N. Y.
Ryerson & Son, Inc., Jos. T., Chicago, Ill.
Wiedemann Mach. Co., Phila., Pa.

PUNCHING and SHEARING MACHINES
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Huot Mfg. Co., St. Paul, Minn.

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Firth-Sterling Steel Co. McKeesport, Pa.
Gisholt Machine Co., Madison, Wis.
Greenfield Tap & Die Corp., Greenfield, Mass.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.

REAMERS, Power
Enterprise Machine Parts Corp., Detroit, Mich.

REAMERS, Solid
Barber-Colman Co., Rockford, Ill.
Butterfield & Co. Div. Union Twist Drill Co., Derby Line, Vt.
Cleveland Twist Drill Co., Cleveland, Ohio
Gisholt Machine Co., Madison, Wis.
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Holman Reamer Co., Manchester, Conn.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Scully-Jones & Co., Chicago, Ill.
Union Twist Drill Co., Athol, Mass.

REAMING MACHINES
Van Norman Machine Tool Co., Springfield, Mass.

RECTIFIERS, Electric Power
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

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Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

REDUCERS, Motorized Speed
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

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General Electric Co., Nela Park, Cleveland, O.

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Norton Co., Worcester, Mass.

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Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

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Cleveland Punch & Shear Works, Inc., Cleveland, Ohio

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Hanna Engineering Works, Chicago, Ill.
Linley Brothers Co., Bridgeport, Conn.

RODS, Welding
Lincoln Electric Co., Cleveland, Ohio

ROLLS, Bending & Straightening
Cleveland Punch & Shear Works, Inc., Cleveland, Ohio

ROPE, Wire
Page Steel & Wire Div. American Chain & Cable Co. Inc., Monessen, Pa.

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Starrett Co., L. S., Athol, Mass.

RULES, Steel & Wood
Brown & Sharpe Mfg. Co., Providence, R. I.
Lufkin Rule Co., Saginaw, Mich.

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Junkin Safety Appliance Co., Louisville, Ky.

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SANDERS, Endless Belt
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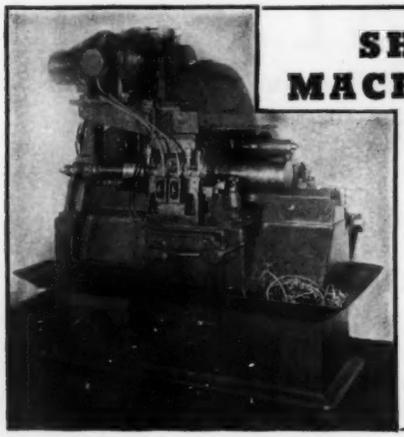

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Porter-McLeod Machine Tool Co., Hatfield, Mass.

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Armstrong-Blum Mfg. Co., Chicago, Ill.
Avey Drilling Machine Co., Cincinnati, Ohio
Disston & Sons, Inc., Henry, Philadelphia, Pa.
Earle Gear & Mach. Co., Phila., Pa.
Peerless Machine Co., Racine, Wis.
Racine Tool & Machine Co., Racine, Wis.

SAWS, Band
Armstrong-Blum Mfg. Co., Chicago, Ill.

SAWS, Circular Metal Cutting
Disston & Sons, Inc., Henry, Philadelphia, Pa.

SAWS, Hack
Armstrong-Blum Mfg. Co., Chicago, Ill.
Disston & Sons, Inc., Henry, Philadelphia, Pa.
Starrett Co., L. S., Athol, Mass.

SAWS, Hack, Frames and Blades
Atkins & Co., E. C., Indianapolis, Ind.
Racine Tool & Machine Co., Racine, Wis.
Starrett Co., L. S., Athol, Mass.
Thompson & Son Co., Henry G., New Haven, Conn.

SAWS, Hole
Black & Decker Mfg. Co., Towson, Md.

SAWS, Metal Cutting
Avey Drilling Machine Co., Cincinnati, Ohio
Motch & Merryweather Co., Cleveland, Ohio
Racine Tool & Machine Co., Racine, Wis.

SAWS, Metal Cutting, Band (Machine)
Capewell Mfg. Co., Hartford, Conn.

SAWS, Milling
Barber-Colman Co., Rockford, Ill.
Disston & Sons, Inc., Henry, Philadelphia, Pa.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.

SAWS, Power Hack
Armstrong-Blum Mfg. Co., Chicago, Ill.

SAWS, Screw Slotting
Disston & Sons, Inc., Henry, Philadelphia, Pa.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.

SCREW DRIVERS, Portable Electric
Black & Decker Mfg. Co., Towson Md.

SCREW DRIVERS, Power
Detroit Power Screwdriver Co., Detroit, Mich.

SCREW DRIVING MACHINES
Haskins Co., R. G., Chicago, Ill.

SCREW EXTRACTORS
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Continental-Diamond Fibre Co., Newark, Del.

SCREW MACHINE PRODUCTS
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Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.

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New Britain-Gridley Machine Co., New Britain, Conn.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Warner & Swasey Co., Cleveland, Ohio

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Cleveland Automatic Machine Co., Cleveland, Ohio.
Cone Automatic Machine Co., Windsor, Vt.
National Acme Co., Cleveland, Ohio
New Britain-Gridley Machine Co., New Britain, Conn.
Warner & Swasey Co., Cleveland, Ohio

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Gisholt Machine Co., Madison, Wis.
Jones & Lamson Mach. Co., Springfield, Vt.

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Greenfield Tap & Die Corp., Greenfield, Mass.

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Danly Mach. Spec. Co., Inc., Chicago, Ill.
Eastern Mach. Screw Corp., New Haven, Conn.
Lamson & Sessions Co., Cleveland, Ohio
Standard Pressed Steel Co., Jenkintown, Pa.

SCREWS, Machine
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Eastern Mach. Screw Corp., New Haven, Conn.

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Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
Corbin Screw Corp., New Britain, Conn.
International Screw Co., Detroit, Mich.
Lamson & Sessions Co., Cleveland, Ohio
National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Parker Co., Charles, Meriden, Conn.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
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Shakeproof Lock Washer Co., Chicago, Ill.
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Whitney Screw Corp., Nashua, N. H.

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Standard Pressed Steel Co., Jenkintown, Pa.

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Rockford Machine Tool Co., Rockford, Ill.
Smith & Mills Co., Cincinnati, Ohio

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Jones & Laughlin Steel Corp., Pittsburgh, Pa.

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SHARPENING STONES
Carborundum Co., Niagara Falls, N. Y.
Norton Co., Worcester, Mass.

SHEARS, Power
Cincinnati Shaper Co., Cincinnati, Ohio
Cleveland Punch & Shear Works, Inc., Cleveland, Ohio
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Mitts & Merrill, Saginaw, Mich.
Niagara Machine & Tool Wks., Buffalo, N. Y.
Ryerson & Son, Inc., Jos. T., Chicago, Ill.

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Quickwork-Whiting Corp., Harvey, Ill.

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Lincoln Electric Co., Cleveland, Ohio

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Fest, Los Angeles, Calif.

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Douglas Machinery Co., Inc., New York, N. Y.

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Philadelphia Gear Works, Philadelphia, Pa.

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Philadelphia Gear Works, Philadelphia, Pa.

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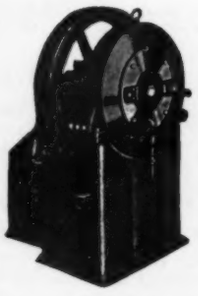

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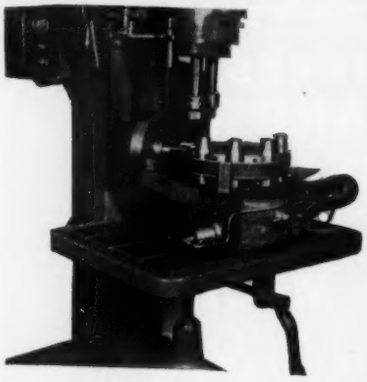
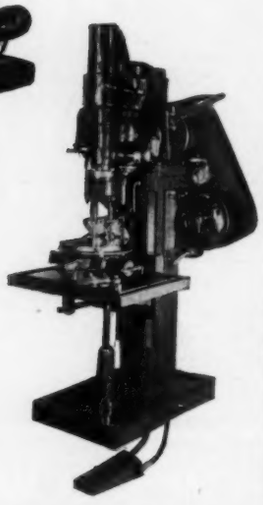


Dial arranged for holding shells for tapping, parts being loaded by hand, clamped and ejected automatically.



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Continental Machines, Inc., Minneapolis, Minn.

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STARTERS, Motor
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STEEL, Alloy Carbon
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Wyckoff Drawn Steel Co., Pittsburgh, Pa.

STEEL, Alloy, Cold Drawn
Firth-Sterling Steel Co. McKeesport, Pa.
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Wyckoff Drawn Steel Co., Pittsburgh, Pa.

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Ryerson & Son, Inc., Jos. T., Chicago, Ill.

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Firth-Sterling Steel Co. McKeesport, Pa.

STEEL, Cold Finished
Firth-Sterling Steel Co. McKeesport, Pa.
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STEEL, Die
Firth-Sterling Steel Co. McKeesport, Pa.

STEEL, High Speed
Armstrong Bros. Tool Co., Chicago, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., Reading, Pa.
Crucible Steel Co., New York, N. Y.
Firth-Sterling Steel Co. McKeesport, Pa.
U. S. Steel Corp., Pittsburgh, Pa.
Vascoloy-Kamet Division Vanadium Alloys Steel Co., Chicago, Ill.
Williams & Co., J. H., Buffalo, N. Y.

STEEL, Rustless & Stainless
Carpenter Steel Co., Reading, Pa.
Crucible Steel Co., New York, N. Y.
Firth-Sterling Steel Co. McKeesport, Pa.
Ingersoll Steel & Disc. Div. Borg Warner Corp., New Castle, Pa.
Republic Steel Corp., Cleveland, Ohio
Ryerson & Son, Inc., Jos. T., Chicago, Ill.
U. S. Steel Corp., Pittsburgh, Pa.

STEEL, Screw
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Wyckoff Drawn Steel Co., Pittsburgh, Pa.

STEEL, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Carpenter Steel Co., Reading, Pa.
Cleveland Twist Drill Co., Momax Div., Cleveland, Ohio
Crucible Steel Co., New York, N. Y.
Firth-Sterling Steel Co. McKeesport, Pa.
Ryerson & Son, Inc., Jos. T., Chicago, Ill.
U. S. Steel Corp., Pittsburgh, Pa.

STEELS, Alloy, Carbon and High Speed
Bethlehem Steel Co., Bethlehem, Pa.
Ingersoll Steel & Disc. Div. Borg Warner Corp., New Castle, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, Ohio
Ryerson & Son, Inc., Jos. T., Chicago, Ill.
U. S. Steel Corp., Pittsburgh, Pa.
Vanadium Alloys Steel Co., Latrobe, Pa.

STOOLS, Steel
Standard Pressed Steel Co., Jenkintown, Pa.

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Ford Motor Co. (Johansson Div.), Dearborn, Mich.

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Springfield Mach. Tool Co., Springfield, Ohio

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Aluminum Co. of America, Pittsburgh, Pa.

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Modern Tool Works, Div. Consolidated Machine Tool Corp. of America, Rochester, N. Y.

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Waltham Machine Works, Waltham, Mass.

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Torrington Co., Torrington, Conn.

SWITCHES
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Allen Mfg. Co., Hartford, Conn.

TAPER PINS
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.

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Lufkin Rule Co., Saginaw, Mich.
Starrett Co., L. S., Athol, Mass.

TAP HOLDERS
Scully-Jones & Co., Chicago, Ill.

TAPPERS, Portable Electric
Black & Decker Mfg. Co., Towson, Md.

TAPPERS, Single & Multi-Spindle
Armstrong-Blum Mfg. Co., Chicago, Ill.

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Barber-Colman Co., Rockford, Ill.
Cincinnati Bickford Tool Co., Cincinnati, Ohio
Haskins Co., R. G., Chicago, Ill.
Kaufman Mfg. Co., L. J., Manitowoc, Wis.
Kingsbury Machine Tool Co., Keene, N. H.
Moline Tool Co., Moline, Ill.
Murchey Machine & Tool Co., Detroit, Mich.

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Geometric Tool Co., New Haven, Conn.

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Hanson-Whitney Machine Co., Hartford, Conn.
Landis Machine Co., Waynesboro, Pa.
Murchey Machine & Tool Co., Detroit, Mich.
Pratt & Whitney Division Niles-Bement-Pond Co., Hartford, Conn.

TAPS, Collapsing
Landis Machine Co., Waynesboro, Pa.
Modern Tool Works, Div. of Consolidated Mach. Tool Corp. of America, Rochester, N. C.
Murchey Machine & Tool Co., Detroit, Mich.

TAPS, Ground
Butterfield & Co. Div. Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W., Mansfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Machine Co., Hartford, Conn.
Wood & Spencer Co., Cleveland, Ohio

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Shore Instrument & Mfg. Co., Jamaica, N. Y.
Wilson Mechanical Instrument Co., New York, N. Y.

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Excello Corp., Detroit, Mich.
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Grant Mfg. & Machine Co., Bridgeport, Conn.
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Warner & Swasey Co., Cleveland, Ohio

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Hanson-Whitney Machine Co., Hartford, Conn.
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Murchey Machine & Tool Co., Detroit, Mich.
Rivett Lathe & Grinder Inc., Boston, Mass.

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Warner & Swasey Co., Cleveland, Ohio

TONGS, Lifting
Armstrong Bros. Tool Co., Chicago, Ill.

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Ready Tool Co., Bridgeport, Conn.
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Williams & Co., J. H., Buffalo, N. Y.

TOOL STANDS
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TOOLS, Boring
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Bullard Co., Bridgeport, Conn.
Carboloy Co., Detroit, Mich.
Gisholt Machine Co., Madison, Wis.
Jones & Lamson Machine Co., Springfield, Vt.
Warner & Swasey Co., Cleveland, Ohio

TOOLS, Carbide Alloy
Carboloy Co., Detroit, Mich.
Jones & Lamson Machine Co., Springfield, Vt.
McKenna Metals, Latrobe, Pa.
Vascoloy-Ramet Division Vanadium Alloys Steel Co., Chicago, Ill.
Warner & Swasey Co., Cleveland, Ohio

TOOLS, Cutting
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Jones & Lamson Machine Co., Springfield, Vt.
Warner & Swasey Co., Cleveland, Ohio

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Williams & Co., J. H., Buffalo, N. Y.

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TOOLS, Knurling
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McKenna Metals, Latrobe, Pa.
Warner & Swasey Co., Cleveland, Ohio

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Williams & Co., J. H., Buffalo, N. Y.

TOOLS, Pipe Threading
Armstrong Bros. Tool Co., Chicago, Ill.
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Williams & Co., J. H., Buffalo, N. Y.

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Williams & Co., J. H., Buffalo, N. Y.

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Jones & Lamson Machine Co., Springfield, Vt.
McKenna Metals, Latrobe, Pa.
Warner & Swasey Co., Cleveland, Ohio

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Jones & Lamson Machine Co., Springfield, Vt.
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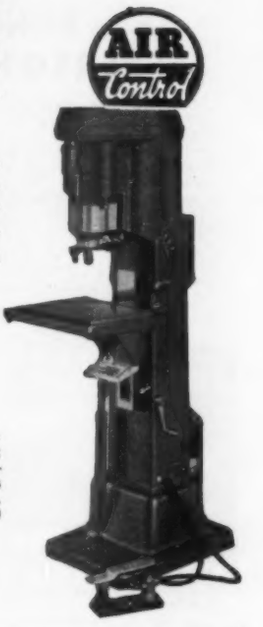

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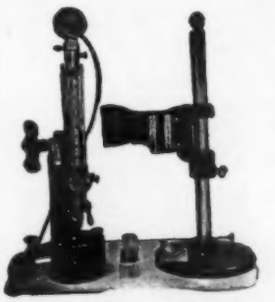

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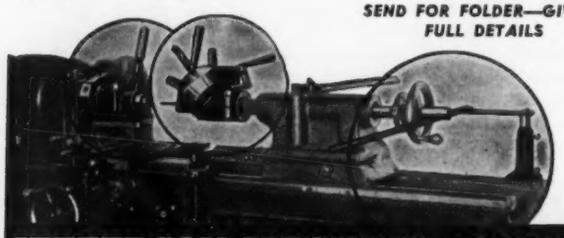

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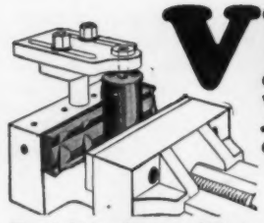

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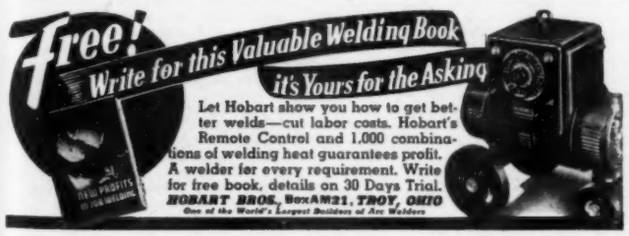
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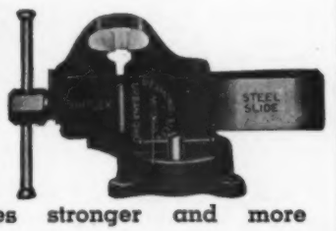

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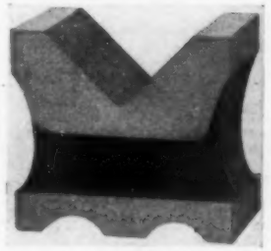

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